Railway Engineering Maintenance

Adds Years To Tie Life!

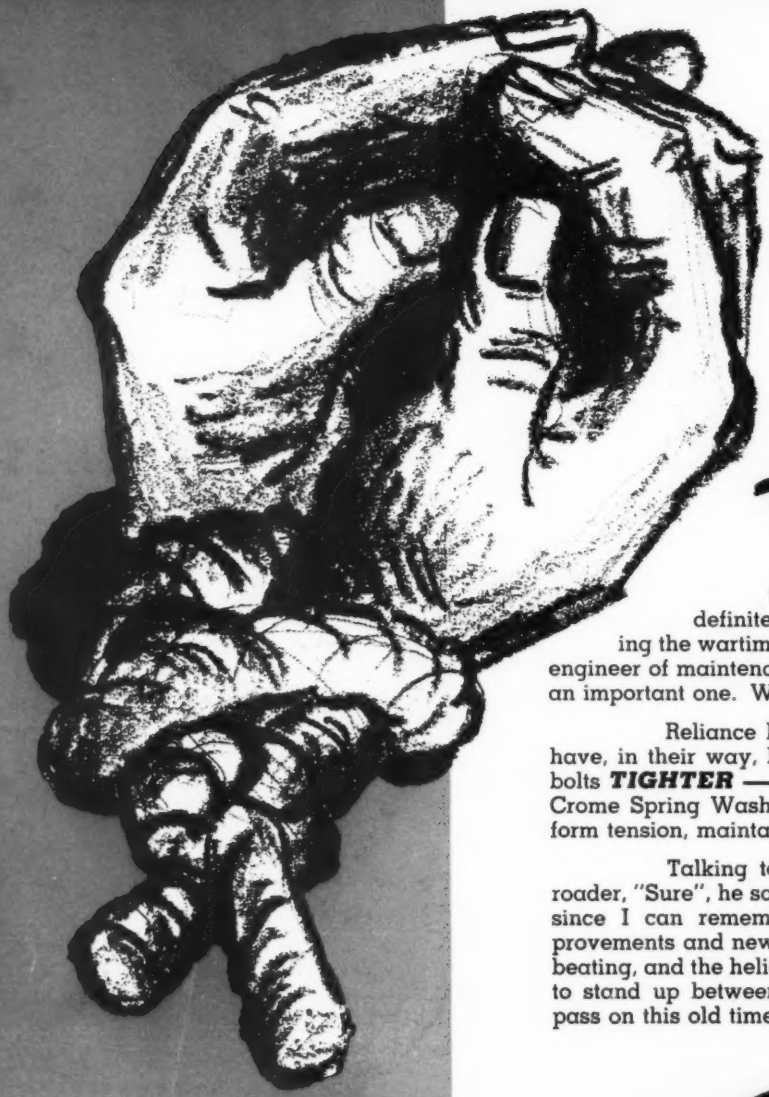
THE DENVER & RIO GRANDE WESTERN R. R.
NEAR HELPER, UTAH

The Improved
FAIR

CHICAGO • NEW YORK • DENVER
WASHINGTON • ST. LOUIS

THE P. & M. CO.

CLEVELAND • ST. PAUL
BOSTON • SAN FRANCISCO



THE BIGGEST JOB EVER.... AND THEY DID IT WITH THEIR *HANDS* TIED!

Unknown are the many railroad track maintenance men who have made definite contributions to railroad efficiency during the wartime emergency period. The job from chief engineer of maintenance down to the track walker has been an important one. We salute their achievements.

Reliance Hy-Pressure Hy-Crome Spring Washers have, in their way, helped these men by keeping rail joint bolts ***TIGHTER — LONGER.*** Reliance Hy-Pressure Hy-Crome Spring Washers, by exerting that all important uniform tension, maintains efficient rail joint bolt conditions.

Talking to a track supervisor, an old time railroader, "Sure", he said, "we have used Spring Washers ever since I can remember. 'Course, there's been many improvements and new designs. They help rail joints take the beating, and the helical Spring Washer gives it what it needs to stand up between tightening periods." We are glad to pass on this old timer's comments for your consideration.

"Edgemark of Quality"

MEMBER

Write Today for six page folder on Reliance Hy-Crome Spring Washers for track and find out how Reliance Hy-Pressure Hy-Crome Spring Washers can meet your toughest assignment.

EATON

EATON MANUFACTURING COMPANY

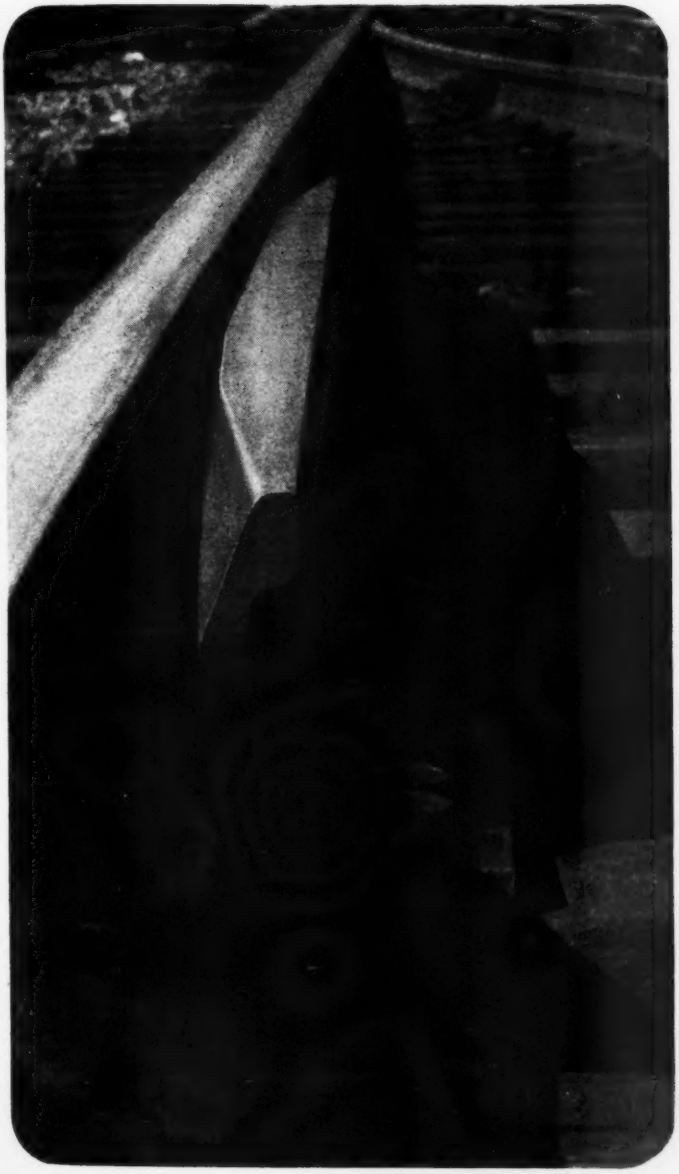
MASSILLON, OHIO

Reliance Division

Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montre

HUSKY...

but that's only ONE of its advantages



For many years, Bethlehem's Hook Flange Guard Rail has been known for its ruggedness and durability. Much of its reputation has been built on that ruggedness (we've never heard of one breaking under traffic). But in other ways, too, this guard rail's a winner.

Look at its end-construction, for instance. See how the section is tapered and sloped so that trucks ease smoothly into line, reducing the chances of cracked or chipped wheels.

And note, too, how the hook flange passes under the base of the running rail, so that the weight of the train keeps the guard rail from overturning. And the special tie plates . . . they're shouldered against the guard rail, preventing lateral movement.

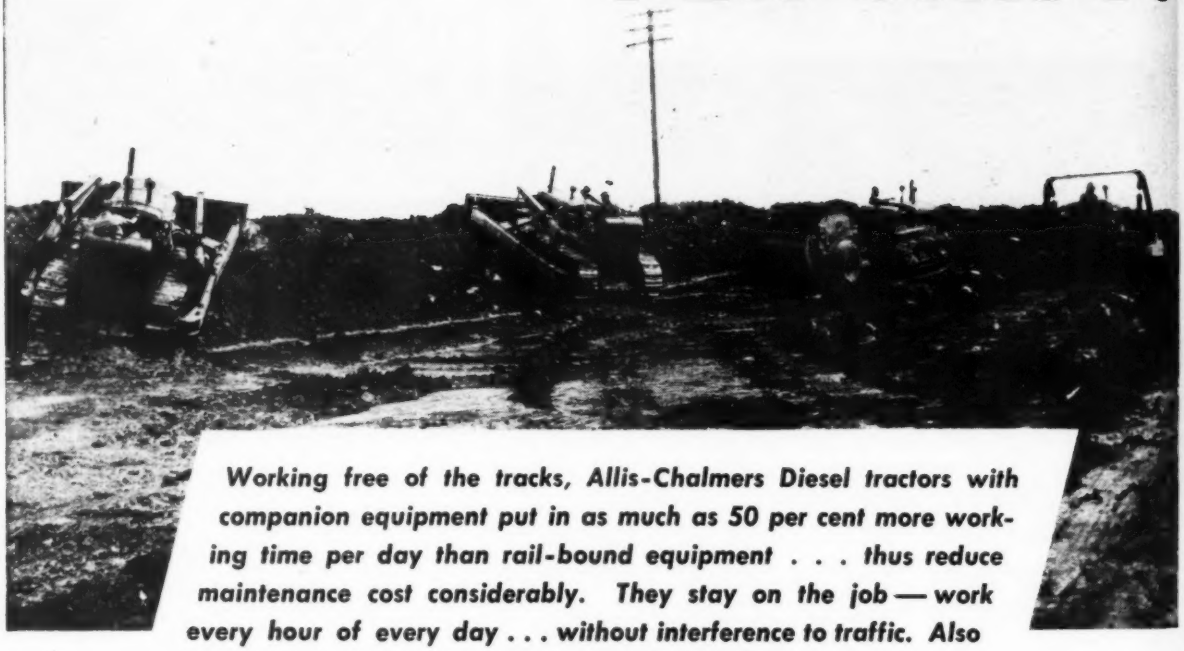
All these features add up to one thing—a husky, low-maintenance guard rail that will give you years of service in high-speed, main-line track... or in large classification yards... or on slips and crossings. Ask a Bethlehem man for more details.

Bethlehem Hook Flange Guard Rail

BETHLEHEM STEEL

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago 3, Ill. Subscription price: United States and Possessions, and Canada, $3.00; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1913 at the post office at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., post office. Address communications to 105 W. Adams St., Chicago 3, Ill.

50% MORE PRODUCTIVE HOURS PER SHIFT!



Working free of the tracks, Allis-Chalmers Diesel tractors with companion equipment put in as much as 50 per cent more working time per day than rail-bound equipment . . . thus reduce maintenance cost considerably. They stay on the job — work every hour of every day . . . without interference to traffic. Also handle grading impossible to reach with work trains.

Fast, powerful Allis-Chalmers Diesel tractors are the ideal machines for your roadbed restoration. They go to work quicker — start as easily as an automobile, on Diesel fuel! Respond instantly to the throttle, are easily maneuvered . . . provide greater flexibility in speed with less gear shifting. 200-hour truck wheel lubrication saves one-half hour every shift . . . adds over six per cent more working time.

Investigate this modern, time-and-money-saving method NOW! We will gladly put you in contact with your Allis-Chalmers dealer. Write.

★

Here a fleet of Allis-Chalmers tractors hurry the widening and strengthening of a roadbed along the Ft. Worth & Denver City right-of-way.

★

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Let Us Prove That
FLEX-TOE
Will Save Money For You . . .

MADE BY THE MANUFACTURERS OF THE FAMOUS DEVIL LINE OF TRACK TOOLS

Two Men Can Do the Work of Three

The Flex-Toe Claw Bar pulls spikes without spike maul driving. The bar is thrown onto spikes or bolts in the conventional way and movable toes grab hold and tighten their grip as pressure is applied to the handle. No shimming necessary. There's nothing new to learn.

Do You Believe In Signs?

Flex-Toe is the SAFEST claw bar on the market. With it, you can *back up* your safety signs and *better* your accident reports. Flex-Toe will reduce to a minimum your injuries from spike maul driving, from flying spike heads, and from falls. Here is an easy way to avoid costly casualties.

One Man, No Helper Necessary

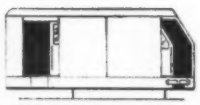
Since spike maul driving is unnecessary, since Flex-Toe pulls brine-eaten and headless spikes, and since no shimming is needed, this tool is rightly called a ONE-MAN CLAW BAR. And remember, no helper is necessary. With it your spike-pulling costs will hit a new low.

Pulls Headless and Brine-Eaten Spikes

All spikes and bolts COME OUT. The movable toes grab hold of any piece of protruding metal, and the spikes, which otherwise would be left in, or driven through, are removed with no more effort than pulling an ordinary spike. *Ties last longer* and your maintenance costs are reduced. Write today for prices.

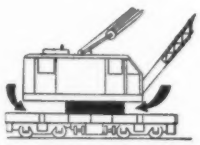
WARREN TOOL CORPORATION · WARREN, OHIO

Insist that your Locomotive Cranes have these SAFETY features:



Sliding doors—never swing out

Wide vision—up, down and sideways

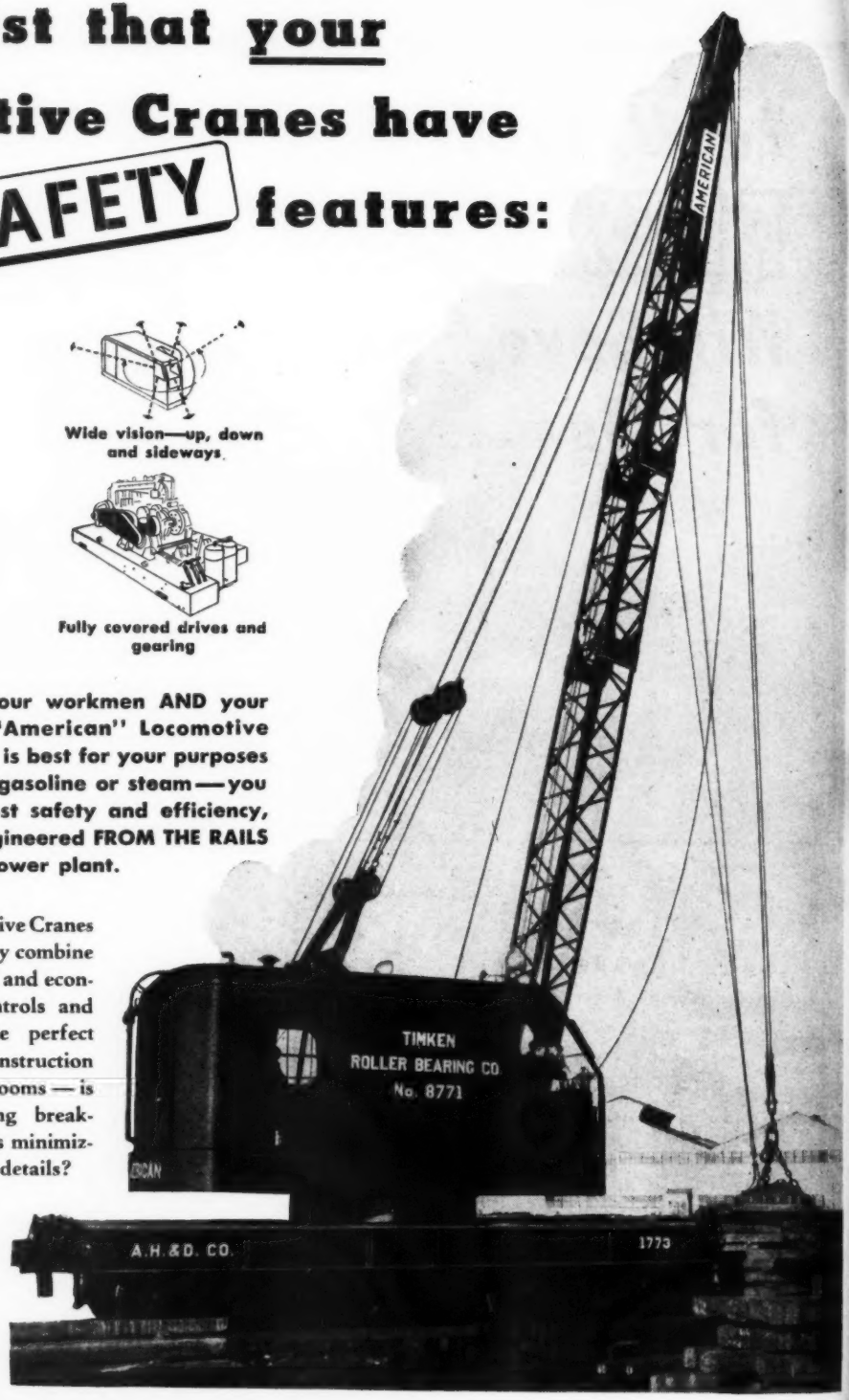


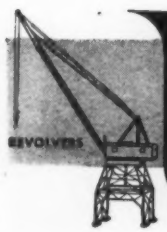
14" Safety Clearance between deck and carbody

Fully covered drives and gearing

Assure the security of your workmen AND your operations by buying "American" Locomotive Cranes. Whichever power is best for your purposes—Diesel, Diesel-electric, gasoline or steam—you will get a crane of utmost safety and efficiency, for each is separately engineered FROM THE RAILS UP to suit its particular power plant.

"AMERICAN" Locomotive Cranes are unique in the way they combine safe operation with speed and economy. Finger-tip air controls and oversize brakes provide perfect control at all times. Construction as a whole — trucks to booms — is extra rugged, preventing breakdown accidents as well as minimizing maintenance. Want details?





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HOIST & DERRICK CO.
St. Paul 1, Minnesota
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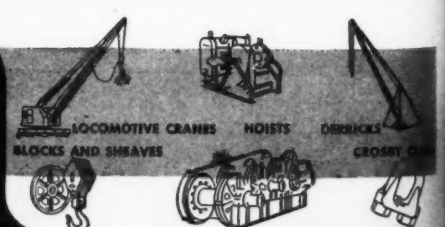


READY TO ROLL

to any Job-

on or off the line!

The Green Bay and Western gets full versatility out of its Northwest Crane This Northwest is always ready to go—ready for any job on the track or *off!*

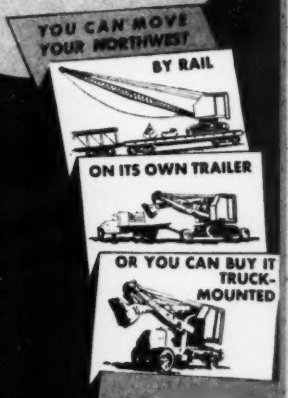
It carries its own portable loading ramp right along with it and a shovel boom is ready to convert the machine for shovel work. Arriving at the job it is quickly unloaded for any class of material handling or excavation. Bank trimming, grading, ditching, bridge work, handling and setting rail, construction of all kinds is all in the day's work and it can do its job on the track or *ten miles away.*

You can't do that with a track crane.

Let us tell you what other railroads are doing with Northwests Remember there is a type and size for every material handling and excavating problem, either crawler mounted or rubber mounted. Ask for details.

NORTHWEST ENGINEERING CO.
1713 Steger Bldg. • 28 E. Jackson Blvd. • Chicago 4, Ill.

YOU CAN'T DO THIS WITH A TRACK CRANE



NORTHWEST

THE ALL PURPOSE RAILROAD MACHINE
SHOVEL • CRANE • DRAGLINE • PULLSHOVEL

PROVED *on the nation's* **LEADING RAILROADS**

For Double Protection Against Rust Use ZINC!

Says the U. S. Bureau of Standards, in Cir. No. 80, "by far the best protective metallic coating for rust-proofing iron or steel" is ZINC.

That statement has been true for over a hundred years, and is likely to be true for a long time yet.

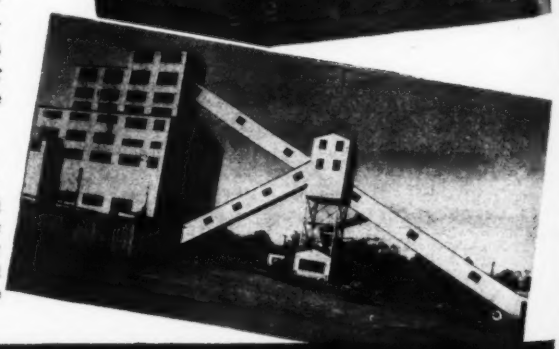
Zinc in the form of a coating protects against rust in two ways:

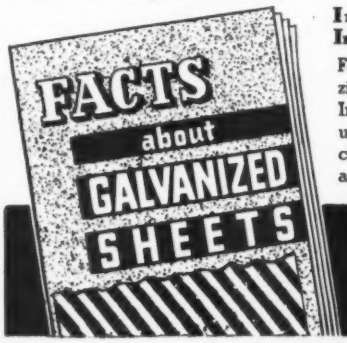
First, by simple coverage, with a sheath of rust-resistant metal.

Second, by electro-chemical action, or "sacrificial corrosion"

Stop Rust! Cut Costs! Save Materials! . . . with ZINC!

Buildings, equipment, machinery — in all of them the use of zinc for protection against rust is good engineering and sensible economy. Zinc can be applied by hot-dip galvanizing, electro-plating, sherardizing, or as a metallic pigment; all these methods are sound and practical for various applications... And specify *heavy* coatings, for the heavier the zinc coating, the better the protection, the longer the service life, and the lower the cost.





Interesting and Valuable Information About ZINC

For practical information about zinc, read the booklets the Zinc Institute has prepared for your use. You can get them without charge by sending us your name and address: a postal will do.

American Zinc Institute
INCORPORATED
60 East 42nd Street, New York 17, N.Y.

Cutting teeth for a helical gear in one of the precision hobbing machines.

We cut our teeth!

To bring you the finest in crawler tractors . . . to assure efficient, economical operation, all gears and spline shafts for Oliver "Cletrac" tractors are cut in our own plant. In this way, we can guarantee the close tolerances . . . the precision fits so necessary for smooth, quiet operation and freedom from excessive maintenance.

Cutting our own gears is but one extra step we take to assure the *extra* quality that is inherent in every Oliver "Cletrac" tractor part. Materials, workmanship and equipment are all based on one standard . . . the built-in quality that means added years of service.

Maintenance of that standard enables your Oliver "Cletrac" dealer to offer you the finest in crawler tractors . . . for your every need.

CLETRAC

OLIVER Cletrac

a product of

The OLIVER Corporation

EATING SNOW DRIFTS

with the BROS ROTARY SNOW PLOW

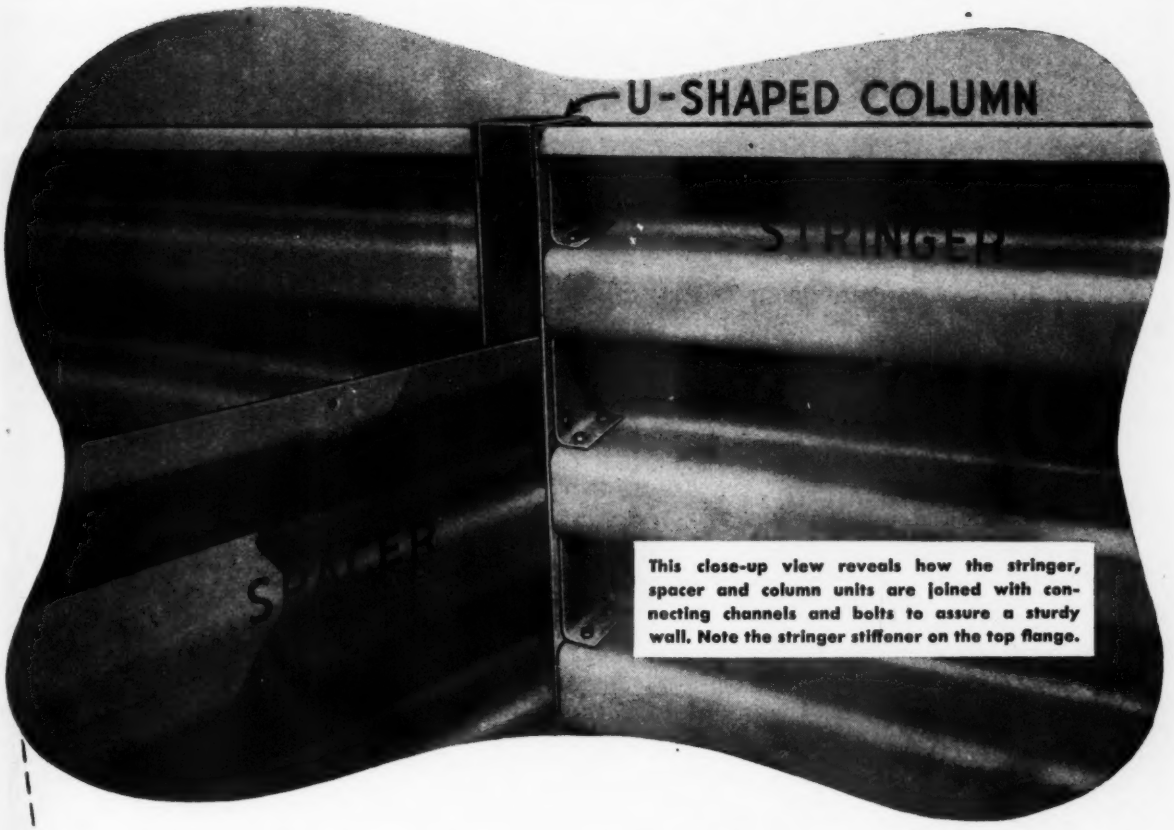
● There is no bucking of snow drifts with this plow—you cut them down with the revolving feeder rake that is hydraulically controlled. At the same time you cut down truck maintenance and fuel consumption as much as 75%.

This revolving feeder rake, an exclusive Bros feature, will handle the deepest snow without stalling and without push-backs. It is the master of all snow and ice. Wm. Bros Boiler & Manufacturing Company, Minneapolis, Minn.

Give Us Your Snow Problems . . . We'll Give You the Answer

BROS

FABRICATORS OF STEEL • BOILERS • STOKERS • TANKS • ROAD EQUIPMENT



This close-up view reveals how the stringer, spacer and column units are joined with connecting channels and bolts to assure a sturdy wall. Note the stringer stiffener on the top flange.

STEEL WALLS THAT *TAKE THE "BITE"* OUT OF EROSION

Only the passengers get a thrill out of high embankments that skirt the edges of rivers, lakes, and adjacent roadways. To railroad men these slopes bring nothing but headaches. They are easy prey for sharp-biting erosion and other unstable conditions.

Many maintenance engineers solve these problems by installing ARMCO Bin-Type Retaining Walls.

These sturdy walls overcome unequal settlement without cracking or bulging. They are so easy to erect that unskilled men can do it in any season, with less excavating. Backfilling is done as the work progresses, to prevent undermining during construction.

Economy and efficiency go hand-in-hand. Closed bin construction prevents loss of material from individual cells. ARMCO Bin-Type Walls can be salvaged for use elsewhere or changed to meet other conditions in the same location.

Get all the facts about ARMCO Retaining Walls. You'll find them a money-saving remedy for war-beaten roadbeds. Write Armco Railroad Sales Co. Inc., 2641 Curtis Street, Middletown, Ohio.

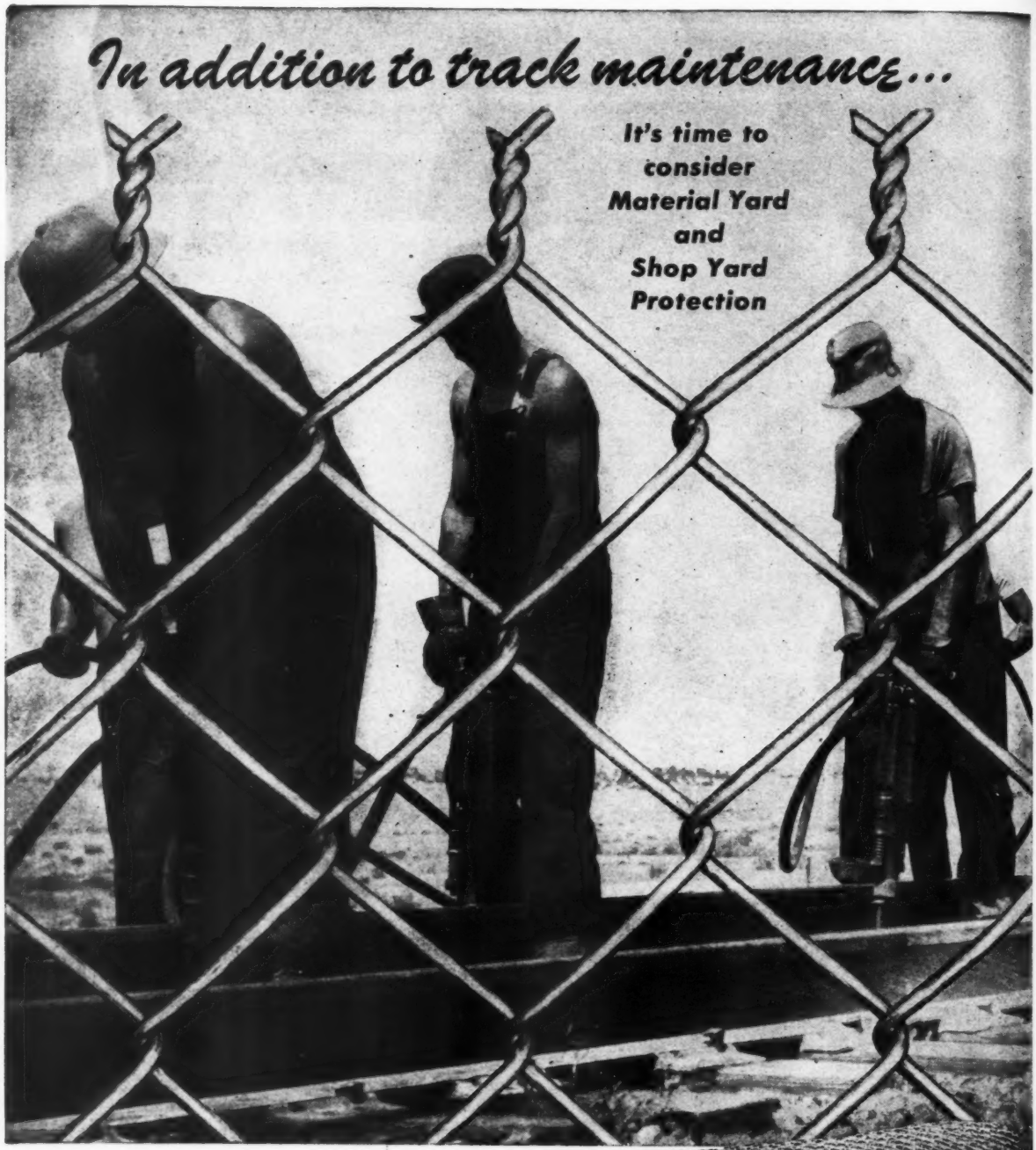
ARMCO Bin-Type Retaining Wall used as headwall extensions on a large culvert.

ARMCO

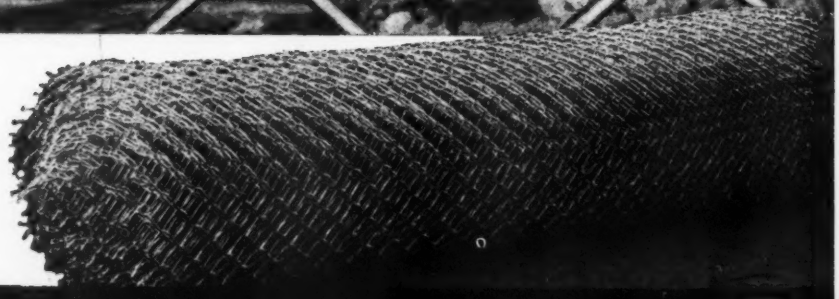
ARMCO BIN-TYPE RETAINING WALLS

In addition to track maintenance...

It's time to consider Material Yard and Shop Yard Protection



Colorado Chain Link Fabric and Complete Chain Link Fence



The **Colorado Fuel** *and* **Iron Corporation**

General Offices: Denver, Colo. Steel Works: Pueblo, Colo.

CF&I STEEL

PLAN YOUR 1946 WEED CONTROL PROGRAM *Now!*

WEED-FREE TRACK is always a mark of good maintenance. Call on us to help you lay out a weed control program that will insure clean track. We can now make plans on the use of the right chemicals to suit your conditions.

Atlacide Chlorate Weed Killer is again freely available, as well as the old standby Atlas "A." We shall be glad to discuss any special requirements with a view to providing the most effective chemicals to fit your program.

Early planning will insure prompt supply of materials and a satisfactory job throughout.

ATLACIDE
CHLORATE WEED KILLER

ATLAS "A"
ARSENICAL

Chipman Standard Spray Train in action

CHIPMAN CHEMICAL COMPANY, INC.

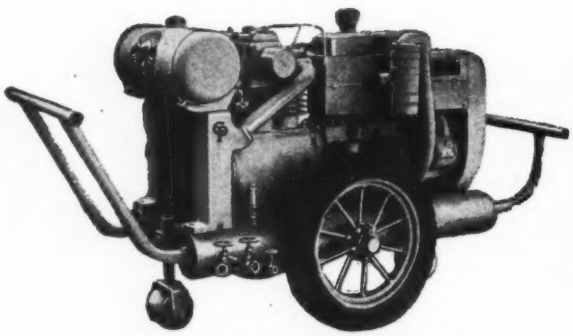
Chicago, Ill. · BOUND BROOK, NEW JERSEY · Portland, Ore.

Houston, Texas · Palo Alto, Calif. · No. Kansas City, Mo. · Winnipeg, Man.

MEMBER

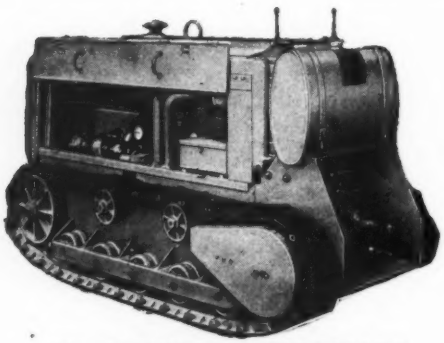
Speed Up
TRACK AND BRIDGE REPAIRS with CP TIME-SAVING EQUIPMENT

Gasoline and Diesel-driven portable compressors, in a variety of railway mountings . . . easily handled, low air consumption tie tampers . . . speedy pneumatic wrenches . . . fast-working spike drivers and wood-borers . . . pneumatic and electric concrete vibrators — these are only a few of many items of time-saving CP Maintenance-of-Way Equipment. Write for further information on any of the equipment illustrated or listed in these pages.



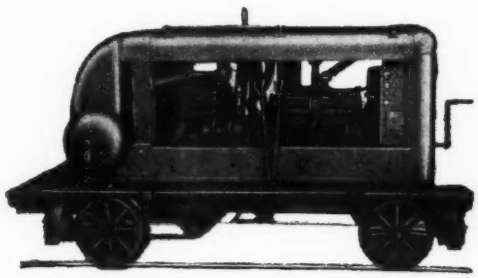
CP PATROL COMPRESSOR

Designed especially for spot tamping and track or bridge repair work; completely air-cooled for all year 'round service. Actual capacity, 60 c.f.m. at 100 pounds. Operates 4 CP Tie Tampers or any combination of tools of equivalent rating.



CP CRAWLER COMPRESSOR

Propels itself in either direction, travels between or across rails, turns around on its own center, will not tip over at a 45° angle. Sizes, 105 and 160 c.f.m., actual capacities; will operate eight or twelve CP Tie Tampers, respectively, or any combination of tools of equivalent rating.

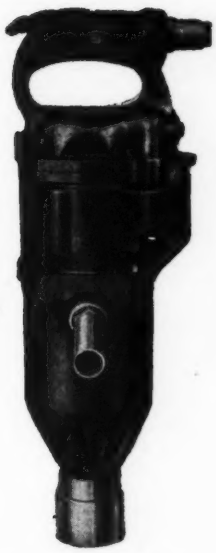


CP FLANGED-WHEEL COMPRESSORS

CP Portable Compressors, self-propelled and non-self-propelled, are available in sizes of 105 to 500 c.f.m. actual capacities. Also furnished on skids and on steel or rubber-tired road wheels.

CP TIE TAMPERS

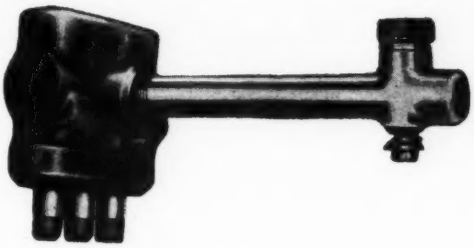
CP Tie Tampers are widely used because of their ease of handling and their low air consumption. Excellent for nipping and equally effective on jobs where the track is raised several inches.



CP PNEUMATIC WRENCHES

(Impact Type)

Ideal for assembling track fastenings, driving screw spikes and lag screws, applying or removing nuts, bolts, etc. There are 7 model CP Pneumatic Wrenches ranging up to 1¾" bolt size. Illustrated is CP 365-RP, capacity 1¼" bolt size.

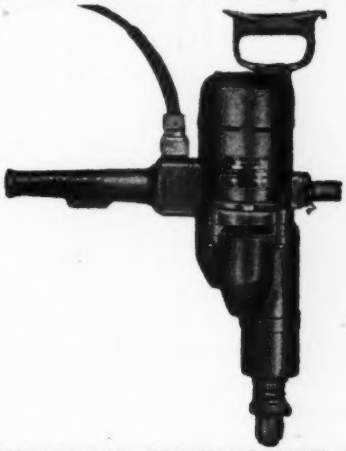


CP TRIPLE SCALER

Operating in unison at high speed, the small but powerful hammers of the CP 404 Triple Scaler cover three times the area of single piston tools.

CP CUT-SPIKE DRIVER

CP 117 Cut-Spike Driver is a powerful, easily handled tool. Finely balanced and easy to hold, has no back kick and does not require riding.



CP UNIVERSAL ELECTRIC NUT RUNNER

CP 989-NC is an ideal electric nut runner for assembling track fastenings, tightening nuts and bolts in all types of maintenance service, particularly bridge and structural steel work. Reversible model of the CP 989-NC also available.

OTHER CP MAINTENANCE-OF-WAY EQUIPMENT

In addition to the equipment illustrated, CP makes a wide range of pneumatic and electric drills, straight and angle grinders, concrete vibrators, and woodborers; pneumatic single piston scaler, chippers, riveters, rivet busters, cement chippers, weld-flux chippers, paint scrapers, sump and sludge pumps, corner drills; sinker drills and demolition tools; also Universal hose and pipe couplings.

MEMBER
THE TRACK SUPPLY ASSOCIATION
TSA

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

BRAND NEW!

"G-AY" MODEL DISSTON CHAIN SAW

with Mercury Gasoline Engine

MODEL G—37AY

MEASURED by every standard, this new Disston Chain Saw is one of the finest cutting tools ever to bear the Disston name. It is a result of exhaustive research by Disston engineers, plus constant study of the performance records of thousands of Disston Chain Saws, which are speeding up production and reducing timber-cutting costs in all parts of the country.

Though unchanged in principle, the new Disston Chain Saw has many improvements: added power and important new features . . . faster, steadier running . . . increased ease and economy of operation . . . greater sturdiness . . . easy to operate . . . etc.

Timbermen, sawmill owners, railroads, contractors, mine owners and other industries, are invited to investigate the merits of this truly remarkable saw and its applications to their particular needs. Mail coupon for full particulars.

OUTSTANDING NEW FEATURES

- Air Cleaner to keep sawdust and dirt from engine and carburetor.
- Fuel Filter (built in gasoline tank).
- Die cast cooling fan.
- Die cast cylinder, with increased number of fins, providing greater cooling area.
- Reduction gear ratio of 3:1—Provides more efficient chain operating speed.
- Positive multiple disc clutch, 13 plates.
- Conveniently located throttle may be set in "open" position.
- Muffler prevents exhaust from annoying operator.
- Equipped with "L" pattern chains.
- Equipped with 3-rib protection cradle underneath engine.
- And others.

DISSTON CHAIN SAW ALSO SUPPLIED WITH PNEUMATIC DRIVE

HENRY DISSTON & SONS, INC.
1041 Tacony, Philadelphia 35, Pa., U. S. A.

HENRY DISSTON & SONS, INC.
1041 Tacony, Philadelphia 35, Pa., U. S. A.

Please send me full particulars regarding Disston Chain Saws.

( ) with Mercury Gasoline Engine ( ) with pneumatic drive.

Your Name.....

Firm Name.....

Address.....

JACKSON UNIVERSAL *Tampers*

PERFECT PRESCRIPTION FOR THE GIGANTIC TRACK PROBLEMS OF RECONVERSION

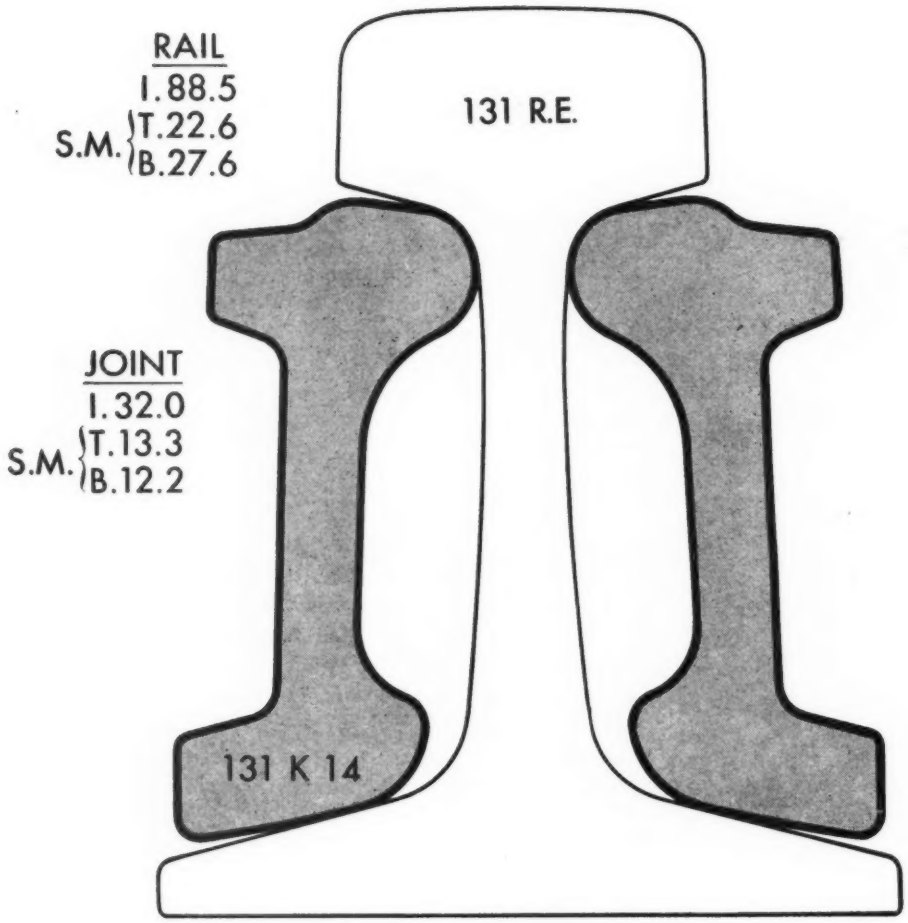
Never in the history of American Railroads has there been such an urgent need for maintenance equipment capable of doing the job better and faster. Roadbeds that will stand up under unprecedented tonnage, capable of sustaining the higher speeds imposed by competition are a reconversion must! And to that end JACKSON Universal Tampers offer a tremendous advantage. They're exceptionally fast and firmly compact all ballasts, in all lifts, with a minimum of labor and maximum uniformity — the only tie tampers with the highly advantageous vibratory action. Let us demonstrate to you why you can expect, and will get, more and better work from JACKSON Universal Tampers and Power Units.

JACKSON WS-4 POWER PLANTS

mounted on light, strong outriggers with insulated roller. Outrigger is recommended where traffic conditions permit, for use on track in spot tamping and similar work where Power Plant must be moved considerable distances. One man can easily remove Power Plant with Outrigger from track in a few seconds.

ELECTRIC TAMPER & EQUIPMENT CO., Ludington, Michigan

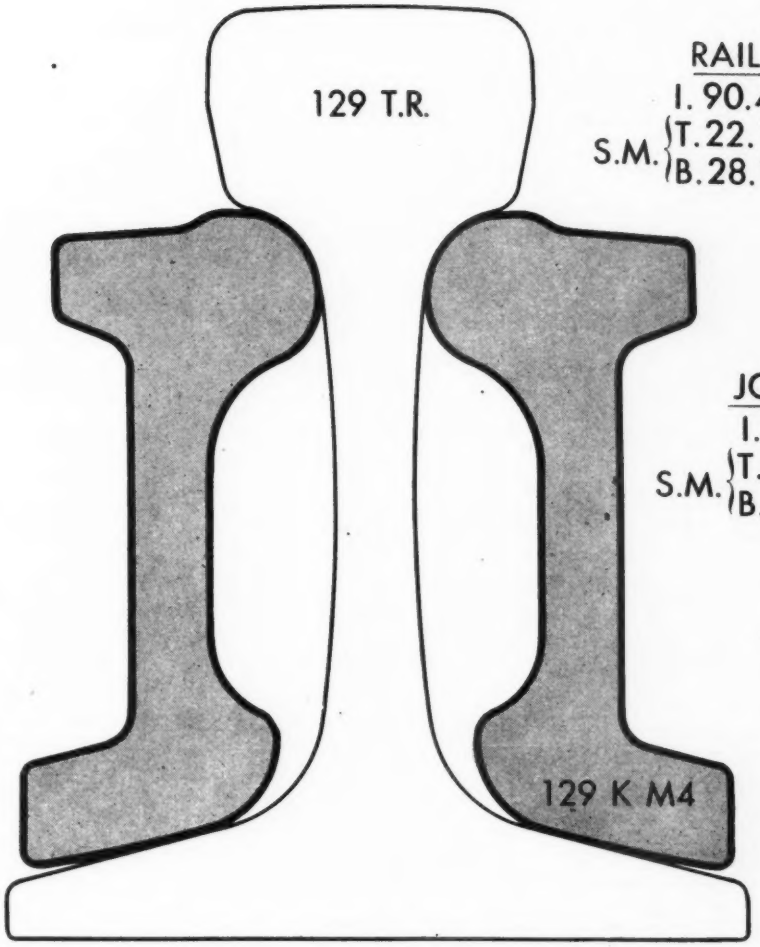
Greater Strength- BETTER FIT



THE HEADFREE Joint has surpassed all other joints in popularity since its inception. It has constantly been improved upon by service and laboratory tests. It fits better, gives greater strength, retains bolt tension longer and affords increased life. The TORSION RESISTING Rail provides a greater head bearing area which further improves this joint bar.

THE RAIL JOINT CO

Longer Life- LOWER COST

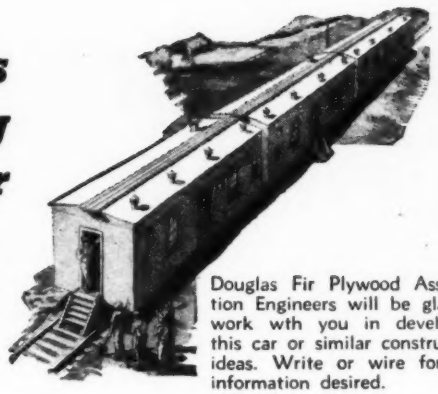


THE TORSION RESISTING Rail is a rail of balanced design. It provides increased torsional rigidity, a stiffer section, a reduction of upper web and fillet stresses caused by eccentric loads, a reduction in weight, and facilitates the design of a stronger joint bar. The TORSION RESISTING Rail in service is proving the theoretical advantages attributed to it.

MPANY, INC. 50 CHURCH ST. NEW YORK 7, N. Y.

Suggested Use of Douglas Fir Plywood in Building a Dining and Lounge Car

THIS DEVELOPMENT IS SUITABLE FOR NEW OR REBUILT CONSTRUCTION—*Fourth of a Series*

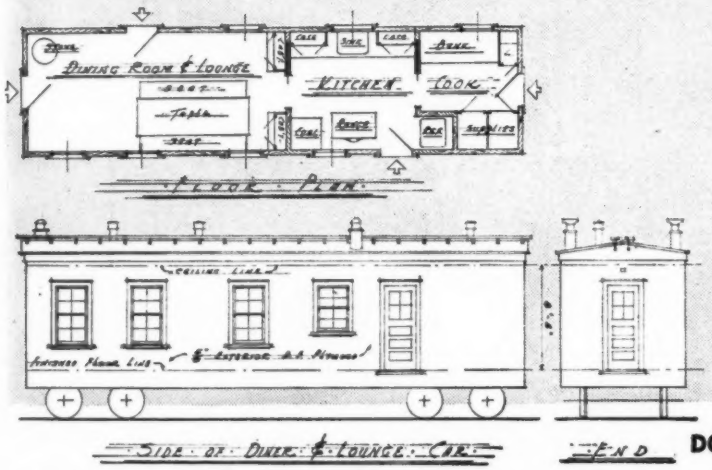


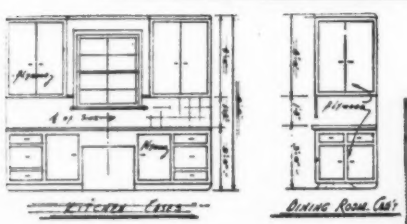
Douglas Fir Plywood Association Engineers will be glad to work wth you in developing this car or similar construction ideas. Write or wire for any information desired.

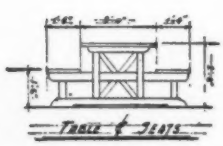
Previous advertisements have shown suggested plans for rebuilding standard 40-foot box cars into a modern three-car camp train and a bay window caboose. Below are suggestions for building a compact and practical diner-lounge car—plans which are again suitable for new or rebuilt construction.

Siding of the car is of 5/8" Exterior type Douglas fir plywood (EXT - DFPA) — the same plywood which has been used so successfully in standard box car, reefer car and troop sleeper construction. Interior is 3/8" Douglas fir plywood. Sliding doors are used between kitchen and dining-lounge area and between kitchen and cook's quarters.

Strong, light in weight, exceptionally durable — Douglas fir plywood is an ideal material for this type of construction. Plywood's panel form speeds installation, reduces the number of seams and cracks, makes cars simpler to heat and freer of drafts. The surface is smooth and attractive, too—and easier to keep clean.







DOUGLAS FIR PLYWOOD ASSOCIATION
Tacoma 2, Washington

SPECIFY DOUGLAS FIR PLYWOOD BY THESE "GRADE TRADE-MARKS"

How to master your cast-iron welding jobs

It's here! Not just another electrode, but the greatest contribution to the welding of cast iron — P&H "Harcast"! Over three years in the making, this new electrode brings amazing results — in easier welding . . . in better welds . . . in time saving. And it's available now for all your cast iron welding.

You'll like "Harcast"! The easy way it handles . . . the smooth weld deposits in all positions. No longer will you have the old troubles of weld cracks, poor penetration, excess porosity and pulling away at the fusion zone. "Harcast" ends all this — makes your cast iron welding simple and sure. Try it and see the difference!

"HARCAST" GIVES YOU—

AC OR DC WELDING

"Harcast" works equally well on either AC or DC. Now, whatever your machine — whatever the cast iron you have to weld . . . it can be done easily and with better results.

ALL POSITION WELDING

Downhand, vertical or overhead. "Harcast" is an all position electrode — makes your welding of cast iron easier.

GREATER TENSILE STRENGTH

Sound, dense welds with a tensile strength of 60,000 lbs. p.s.i. — approximately twice that of a good grade of cast iron.

LOW AMPERE WELDING

"Harcast" was developed for low amperage welding to minimize dilution at the fusion zone, improve machining qualities.

WELDING STEEL TO CAST IRON

A feature that doubles the usefulness of "Harcast." It fuses well with mild or medium carbon steels for joining to cast iron.

SINGLE OR MULTIPLE PASS WELDING

Everything was considered in the development of "Harcast." That's why it is easy to use for single or multiple pass work.

WRITE TODAY FOR TEST SAMPLE OF P&H "HARCAST"

There's an electrode for every requirement in the complete P&H line. P&H welding electrodes are available in all sizes and types for fabricating — repair-welding — for rebuilding and hard-surfacing to provide unusual resistance to wear, impact and abrasion. Let P&H Field Engineers help you with your welding problems.

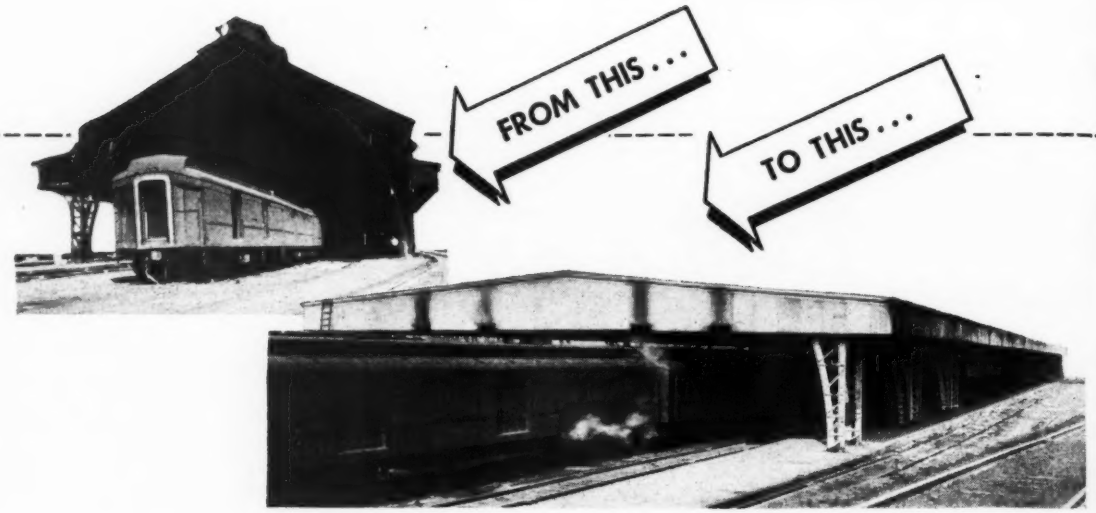
4606 WEST NATIONAL AVENUE, MILWAUKEE 14, WISCONSIN

A COMPLETE ARC WELDING SERVICE • WRITE FOR BULLETIN E7-3

P&H WELDING ELECTRODES

HARNISCHFEGER CORPORATION

WELDING ELECTRODES • MOTORS • HOISTS • ELECTRIC CRANES • ARC WELDERS • EXCAVATORS



Transformed with Transite

MODERNIZED WITH J-M ASBESTOS. Corrugated Transite for the sides, roof deck and smoke slots. Transite "S" Pipe for the flashing cap over the smoke slots.

AT A GLANCE you can see the great change in the general appearance of this modernized Central Station train shed of the Illinois Central, at Chicago.

But of equal importance, though invisible to the camera, is the freedom from rust, rot and corrosion, as well as the protection against fire which J-M Asbestos Transite materials bring to the job.

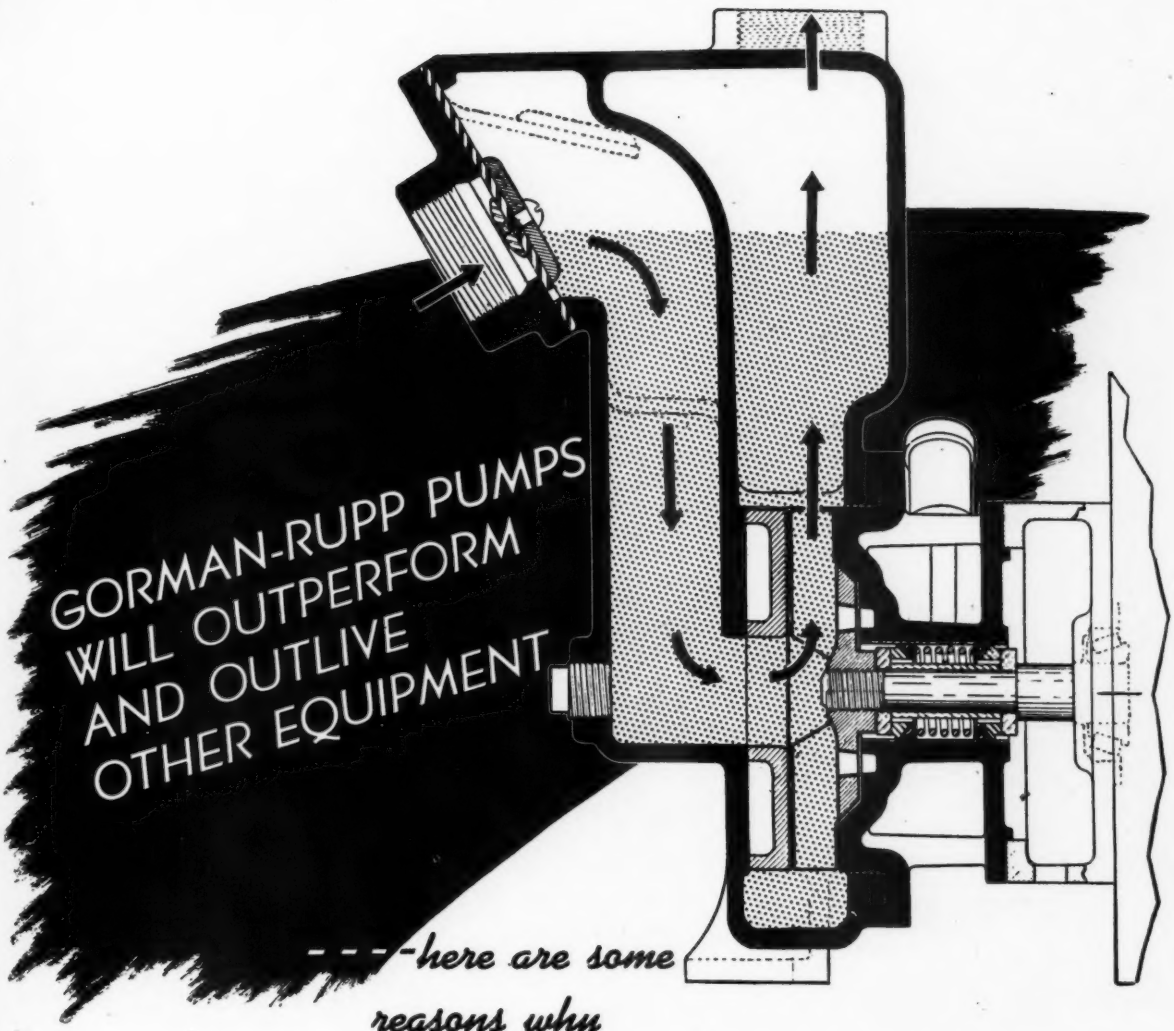
Siding, roof deck and smoke slots are constructed of J-M Corrugated Transite. Made of asbestos and cement, this Transite material eliminates the need for preservative treatment even when exposed to severe weather and operating conditions.

For further information, write Johns-Manville at New York, Chicago, Cleveland, St. Louis or San Francisco.

Johns-Manville

87 YEARS OF SERVICE TO TRANSPORTATION

JOHNS-MANVILLE JM PRODUCTS



----here are some reasons why

You can't get the real story of a Gorman-Rupp pump from looking at the outside. It's the simplicity and good design inside that makes this the most efficient, trouble-free pump you can get. *There are no by-passes, no pipes, no valves – nothing to do in priming but start the motor and you start the water. Since such makeshifts rob a pump of as much as 30 per cent of its running capacity, the greater priming simplicity of Gorman-Rupp pumps pays off in more work for less fuel and power.

*Gorman-Rupp pumps are streamlined inside where streamlining counts! Smooth surfaces, no traps and a design that flows with the water adds another big factor to efficiency and prevents clogging. These pumps will handle any muck or solids that will pass the intake and clear them out of the pump body.

*The G-R impeller operates at motor speed, without reduction gears – another source of wear, trouble and maintenance eliminated. This impeller is the only moving part and rotates on high grade roller bearings.

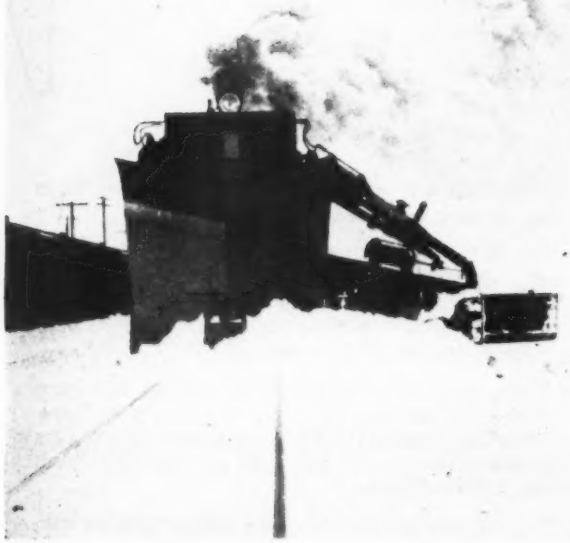
*Every part of a Gorman-Rupp pump has long wear built into it, and every wearing part is replaceable without tearing the pump apart. This maintenance can be done by an unskilled man with common tools.

These are a few reasons why Gorman-Rupp self-priming centrifugal pumps will out-perform and outlive any other comparable equipment. Write for further detailed information.

THE GORMAN-RUPP COMPANY

GORMAN-RUPP PUMPS — UNSURPASSED FOR PUMPING FAST

332 BOWMAN STREET • MANSFIELD, OHIO



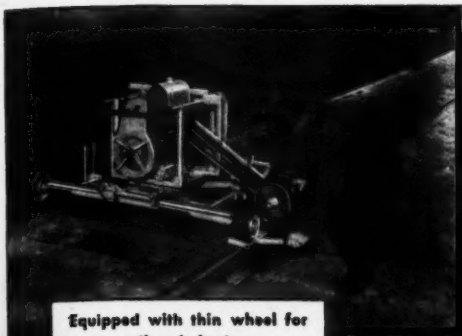
SPREADER-DITCHER SNOW PLOW

The JORDAN multiple-purpose machine is readily converted from a Spreader to a Ditcher to a Snow Plow. This adaptability makes JORDAN an all-year-round machine that is continually on the job making your roadbed maintenance work easier, simpler.

DOES THE WORK OF AN ARMY OF MEN— and does it better!

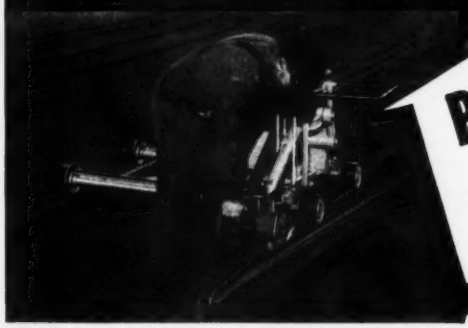
O. F. JORDAN COMPANY EAST CHICAGO INDIANA

Walter J. Riley, *President*



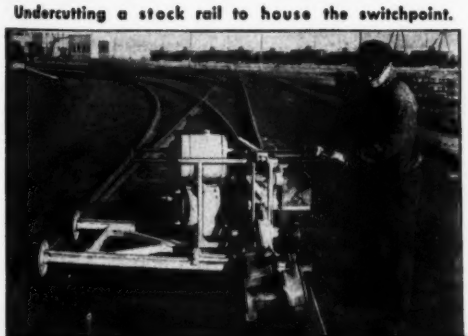
Equipped with thin wheel for rail end slotting.

Flow at switchpoints and stock rails easily removed with double faced cupwheel.



Grinding frog and flangeway reconditioned by welding.

Undercutting a stock rail to house the switchpoint.



Put This Grinder to Work on those Maintenance Jobs

FOR speed and adaptability, the performance of the Nordberg Flexible Arm Grinder is outstanding. It is a simple, fast cutting, easily handled, amply powered grinder that is suitable for a wide variety of rail grinding jobs. Investigate the advantages of this many purpose Flexible Arm Grinder that reduces the cost of rail maintenance.

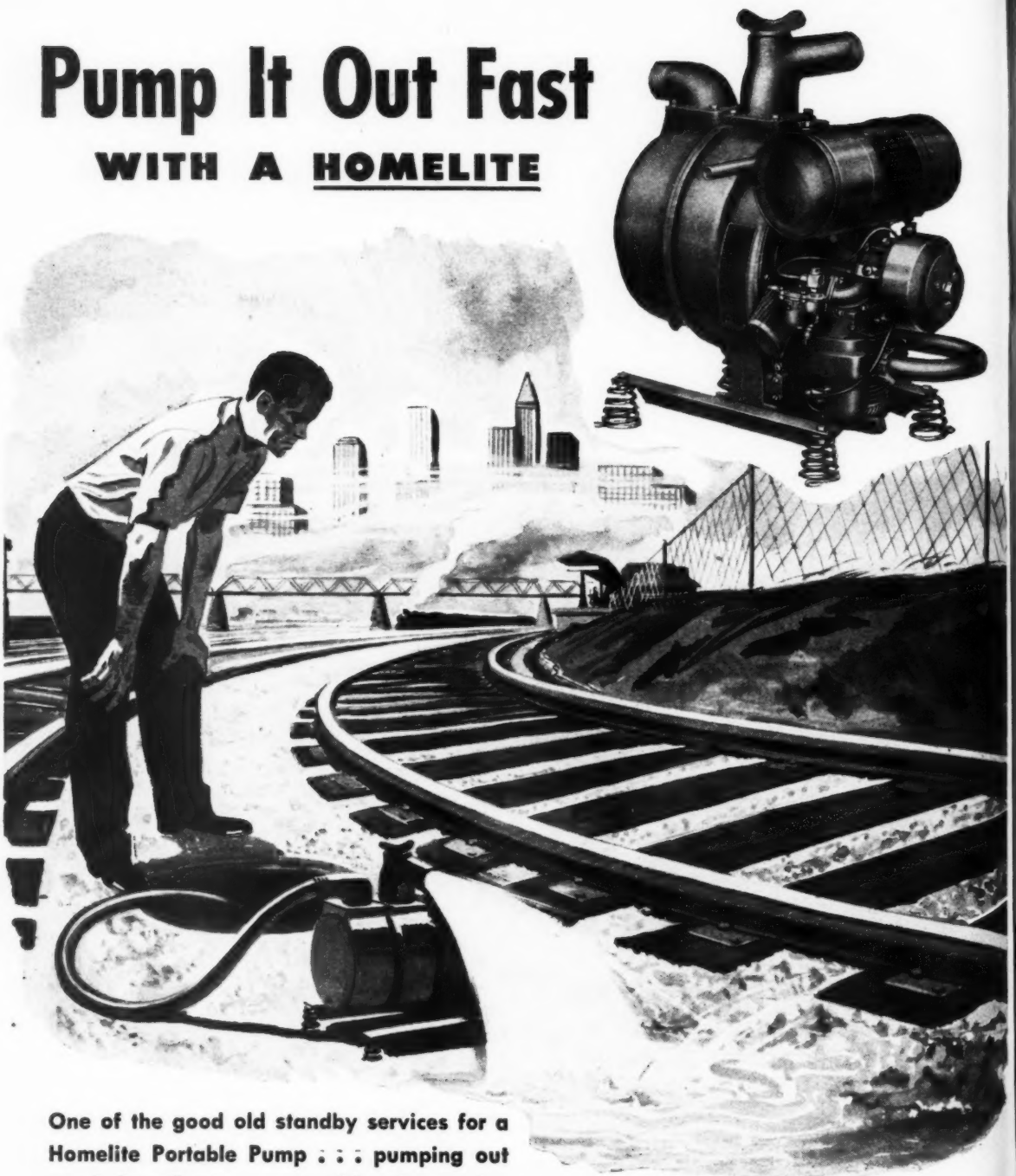
NORDBERG MACHINERY

NORDBERG MFG. CO. MILWAUKEE WISCONSIN

Export Representative—WONHAM Inc.—44 Whitehall St., New York

Pump It Out Fast

WITH A HOMELITE



One of the good old standby services for a Homelite Portable Pump . . . pumping out manholes. Fast . . . capable of pumping 15,000 gallons per hour . . . a Homelite dries out a manhole in no time. It keeps seepage down to strainer level. Gasoline-engine-driven it needs no manual attention. And you can depend on it always.

Homelite gasoline-engine-driven pumps are small enough for a man to carry (they weigh only 88 pounds), but big enough for heavy-duty pumping. Moreover, due to the extreme simplicity of the design of these pumps and the special materials that we have put into them, they'll work longer and with less trouble and maintenance. Send for complete information.

Homelite Corporation

Portable

PUMPS • GENERATORS • BLOWERS

PORT CHESTER, NEW YORK

Spray on

ADDITIONAL MILES

Miles and miles . . . millions of them.

Basically that's a railroad's business . . . buying and selling miles. Rolling stock represents an inventory of miles . . . a flexible inventory that can be stretched to your advantage with Flintkote Car Cements.

These asphalt-base compounds resist wear, abrasion and *corrosion.* They "plate" surfaces with resilient, long-wearing armor. They preserve strength for additional miles of pay load.

Today those miles are especially precious, and more and more maintenance men are discovering that Flintkote Car Cements help to keep cars out of the shop.

Flintkote Car Cements are easily and quickly applied with brush, trowel or spray . . . few hours and the job is done.

For over 40 years The Flintkote Company has served the railroad industry by supplying quality products in Car Cements, Asphalt Protective Coatings, Mastic Flooring, Insulation Coating, Building Materials.

Our Railway Division will be glad to send you full information, or to study any individual problems you may have.

TYPICAL APPLICATIONS OF FLINTKOTE CAR CEMENT

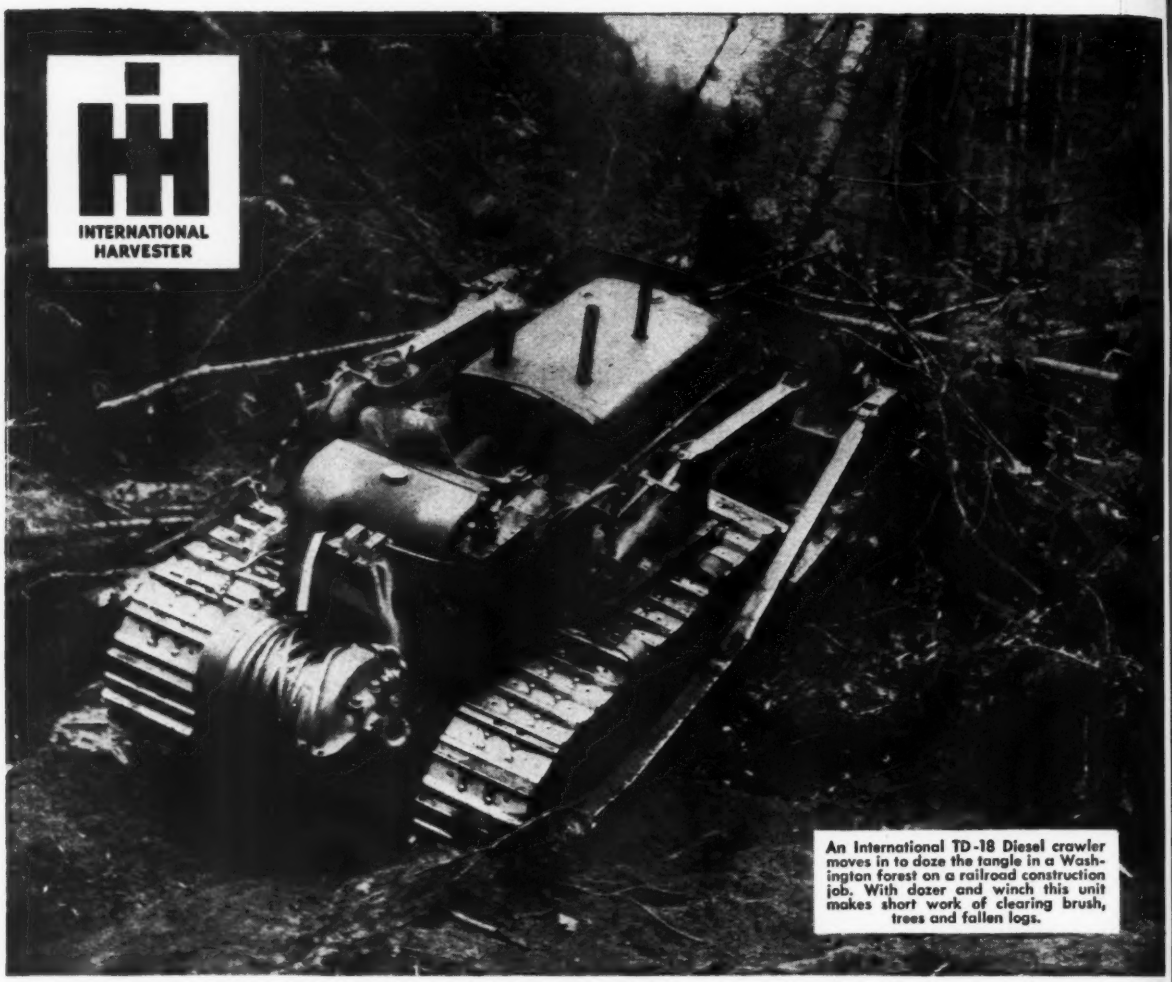
Underframes—all types of freight cars. Box Cars—outside roof . . . ends (side and end posts) . . . over coupler units at each end of floor line . . . inside, under wood lining (ends, sides and roof). Gondola Cars—over coupler units at each end of floor line . . . on underframes. Hopper Cars—underside of slope sheet . . . underframes . . . couplers.

THE FLINTKOTE COMPANY

Industrial Products Division

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Atlanta • Boston • Chicago Heights • Detroit • Los Angeles • New Orleans
Washington • Toronto • Montreal



An International TD-18 Diesel crawler moves in to doze the tangle in a Washington forest on a railroad construction job. With dozer and winch this unit makes short work of clearing brush, trees and fallen logs.

MASTER OF TERRAIN

• Modern International power is the master of terrain. Reshaping mountains and canyons for smooth, safe road beds is all in the day's work for International Diesel TracTracTors.

The big International TD-18 Diesel TracTracTor, rugged veteran of the battlefronts, is job-fitted for the big construction jobs of the railroads and many industries here at home. This applies as well to the other Diesel crawlers in the International line—the sturdy TD-14, TD-9 and TD-6. Each offers the advantages of full Diesel performance and economy in its power range.

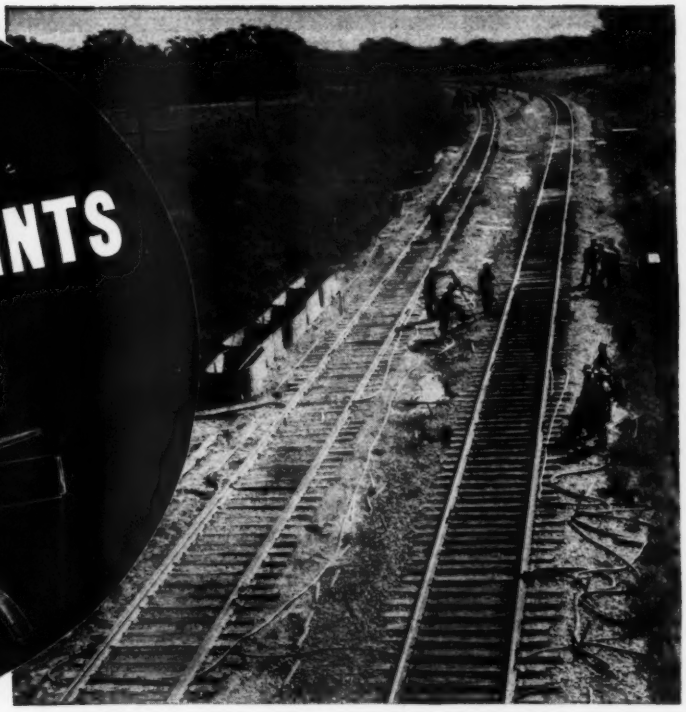
In addition to railroad construction and maintenance-of-way, International TracTracTors, Wheel Tractors, and Power Units, with full Diesel or carburetor-type engines, are assigned to scores of jobs in terminals, shops and yards.

The International Industrial Power Distributor can give you complete information. See him, too, for your parts and service needs.

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago 1, Illinois

INTERNATIONAL Industrial Power

DRIVE GROUTING POINTS FASTER



Maintenance gang on major railroad driving a mud point and pulling a bull point. Thousands of miles of roadbed have been stabilized by this new cement grouting method with no train delays.

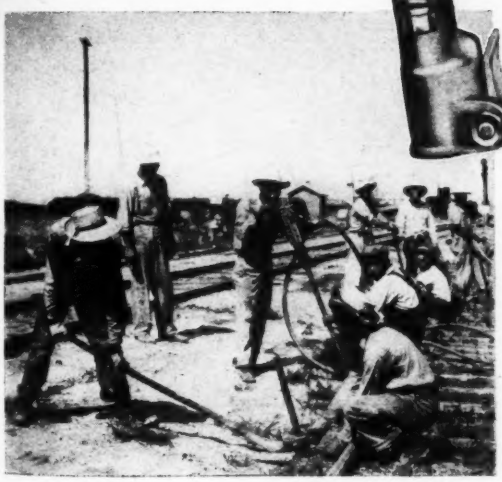
Model 23

WITH *Thor*

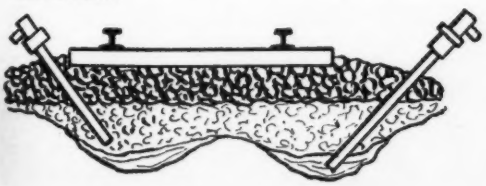
PNEUMATIC BREAKERS

Thor Pneumatic Breakers power the fast, low-cost grouting method that is now widely used to restore roadbeds to original stable condition. Cement grouting fills water pockets in the subgrade and prevents further disturbing accumulations. Mud-points are rapidly and accurately driven by Thor Pneumatic Breakers—*with minimum effort —mile after mile at record speed.* No wonder railroads find that Thor Breakers help to cut grouting costs sharply on the basis of average cost per track-foot.

Thor "measured air" assures maximum power on minimum air consumption—a vital factor when portable compressors are used. Trackmen are able to do more work with less fatigue because Thor Breakers have less vibration . . . *balanced design improves ease of handling.*



Above: Main-line trackage with grouting gang at work. Below: Cross-section shows injection points driven to bottom or below ballast or water pockets. Cement or asphalt-cement grouting is then pumped in through mud-points driven by Thor Pneumatic Breakers.



INDEPENDENT PNEUMATIC TOOL COMPANY

New York 600 W. Jackson Boulevard, Chicago 6, Illinois Los Angeles

Write for new Thor Tool Catalog 52-B for complete details of Thor Breakers and other Thor Air Tools for railroad section and shop work.

Thor PORTABLE POWER TOOLS

PNEUMATIC

UNIVERSAL ELECTRIC HIGH-FREQUENCY ELECTRIC

THE BEST JOB OF PATCHING..... I'VE EVER SEEN!

Fast, Permanent Repairs for Busy Floors with *Quick-Floor*

MAINTENANCE MEN! Cut down maintenance costs on station, shop, roundhouse floors . . . loading platform or driveway surfaces, worn or broken places on bridges, grade crossings, tunnels.

QUICK-FLOOR REPAIRS GIVE ECONOMY . . . SAFETY . . . SPEEDIER AND MORE EFFICIENT MATERIALS HANDLING.

- **No drying time . . . it "sets" by compression and can be used while placing.**
- **No traffic interruptions . . . traffic helps set it and feathers the edges.**
- **No time lost in cutting away old cement.**
- **Ready mixed . . . lower first cost, because no "extras" to buy.**
- **Cuts maintenance costs . . . permanent repairs require no skilled labor.**
- **Use inside or out . . . stands up under severest weather conditions. Won't crack or crumble with vibrations.**
- **Easy to use . . . just place, pack and use immediately.**

Over 100 repeat orders from one national concern proves that Quick-Floor gives lasting satisfaction. Unconditional money-back guarantee. Write for complete details on how Quick-Floor can help you solve your floor maintenance problems.

Experienced floor men wanted as representatives for Dura-Tred Products. For detailed information, address Dura-Tred Company, 355 N. Central Park Blvd., Chicago 24, Ill.

FREE!

Wire brush and tamper with initial 55-gal. drum order.

USE FOR

- Floors, Platforms, Drives
- Building Ramps and Grades
- Filling Spalls, Cracks, Holes, etc.
- Welding Floor Surfaces
- Foot Stands Around Machines
- Any quick, permanent Floor Repair

1782

Quick-Floor MADE BY DURA-TRED COMPANY

355 N. CENTRAL PARK BLVD. · CHICAGO 24, ILL. · VAN BUREN 2171

With its ignition system attached to the gas tank, the light, rugged Barco Tytamper handles any cribbing, spot or gang tamping economically, efficiently. On over 100 railroads, Barcos are keeping rights-of-way in repair, enabling vital rolling stock to give longer service. Whenever you use this versatile tool, winter or summer, you do more work in less time, at lower cost. Write for complete information. Barco Manufacturing Company, Not Inc., 1805 Winnemac Ave., Chicago 40, Illinois. In Canada: The Holden Co., Ltd., Montreal, Canada.

MEMBER
THE TRACK SUPPLY ASSOCIATION TSA

BARCO UNIT TYTAMPERS

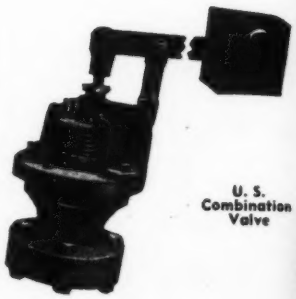
THE FREE ENTERPRISE SYSTEM IS THE SALVATION OF AMERICAN BUSINESS

RAILROAD EQUIPMENT

ENGINEERED and pre-designed quality equipment, built by skilled hands, is certain to meet the most drastic railroad requirements.

Practical experience, scientifically applied with careful workmanship, makes preferred items like the easy operating semaphores and smooth working valves for long and satisfactory service.

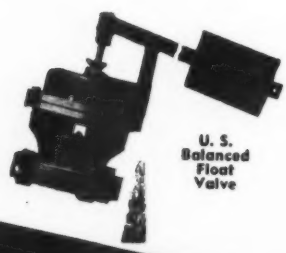
BUY U.S.-CHALLENGE products on your next purchase.



U. S. Combination Valve

Low Semaphore Switch Stand with Revolving Lamp

Halladay Outlet Valve



U. S. Balanced Float Valve

U.S.-CHALLENGE

COMPANY

2000 Wilson St., Batavia, Ill.

Division of Batavia Metal Products, Inc.

Full Speed Ahead

There's no time lost when you operate electric tampers with a Homelite Gasoline-Engine-Driven Generator. The simple reason is this ...A 2000-watt Homelite is light and portable. It can be picked up and moved along with the work, eliminating long cables that drain the power supply.

The best way to see the performance that you get with Homelite Portable Generators, Pumps and Blowers is to have a demonstration given right on an actual job. If you want a free demonstration without obligation, simply write to us. We'll have our nearest representative get in touch with you.

Homelite Corporation

Portable PUMPS • GENERATORS • BLOWERS

PORT CHESTER, NEW YORK

Coming!

- MORE POWER
- LIGHTER WEIGHT
- GREATER SAFETY
- MODERN DESIGN

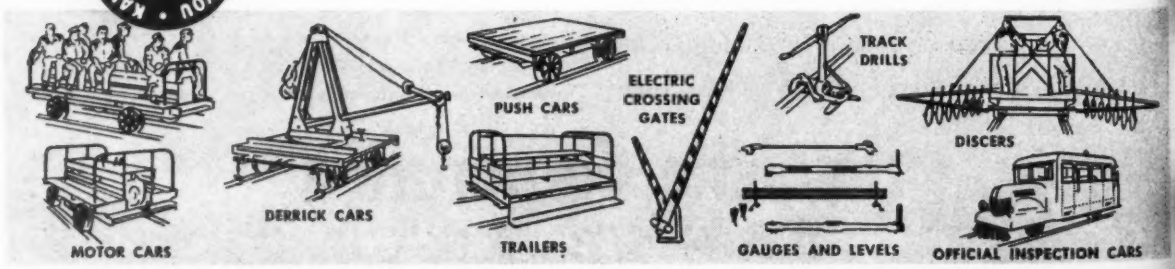
NEW Kalamazoo Motor Cars will be coming out soon with new designs and materials resulting from research during the war. These cars will feature increased power; lighter weight, stronger construction and new safety devices. These features, together with modern functional design, make the new models most desirable to exacting maintenance men. This full range of new motor cars will make a fine contribution to postwar railroad rehabilation and maintenance.

KALAMAZOO MANUFACTURING COMPANY
Railway Supply Division • Kalamazoo 24F, Michigan

KALAMAZOO

Railway Maintenance Equipment

KALAMAZOO MEANS SERVICE TO YOU



12 TOURNAPULLS
FINISH MILWAUKEE RAILROAD JOB AHEAD OF SCHEDULE
in Spite of Rain & Mud

Part of Tournapull fleet on Milwaukee Railroad "hump" removal job. Big tires, low deadweight, high tractive horsepower, made high speed operation possible under "impossible" weather conditions.

Wide top opening of Tournatrailer permitted easy fast loading by shovel. Note the large size, (5'6" x 24") rubber tires which enabled these rigs to work efficiently in removing the refuse and junk during spring rains.

Patented body insured complete ejection of wet, sticky loads. The body slides back on roller bearings over the stationary bed, giving positive, controlled ejection of any type of material.

600,000-yard 60-day job completed in 48 days

A new, larger, level-grade railroad yard for the Chicago, Milwaukee & St. Paul Railroad between Mannheim and Bensenville, Ill., required removing a 600,000 yard switching hump. With a time limit of 60 days, the job was completed in 48, despite 18 days of rain during the first 30! 12 high-speed big-tired Tournapull prime-movers, powering ten 15-yard Carryall Scrapers and two 17-yard Tournatrailers were used in removing the soft and extremely muddy old fill.

Part of the area had been used as a dumping ground, and some 40,000 yards of refuse and junk had to be removed. This was cleared in about 10 working days because the high-traction and low ground-bearing pressure of the Tournatrailers licked haul conditions which, according to H. W. Wipperman of Contractors Raemisch-Madden & McQueen "Would have made truck hauling impossible". During the whole job, handled in rainy spring weather, as Mr. Wipperman puts it: "Tournapulls were often forced to work under seemingly impossible conditions . . . came through with flying colors".

YOU, too, can profit by contracting for use of these high-speed, versatile, off-track Tournapull units on *your* reconstruction. Smaller sizes are available and are especially suited to your railroad maintenance. When the going is really tough and time is a factor, look to the Tournapull line to see the job through with less time, less grief and lower costs. Investigate now. Write to R. G. LeTourneau, Inc., Dept. REM-1045, Peoria, Ill., for more information.

Investigate the small Tournapull with Tiltdozer for your maintenance jobs.

RR6

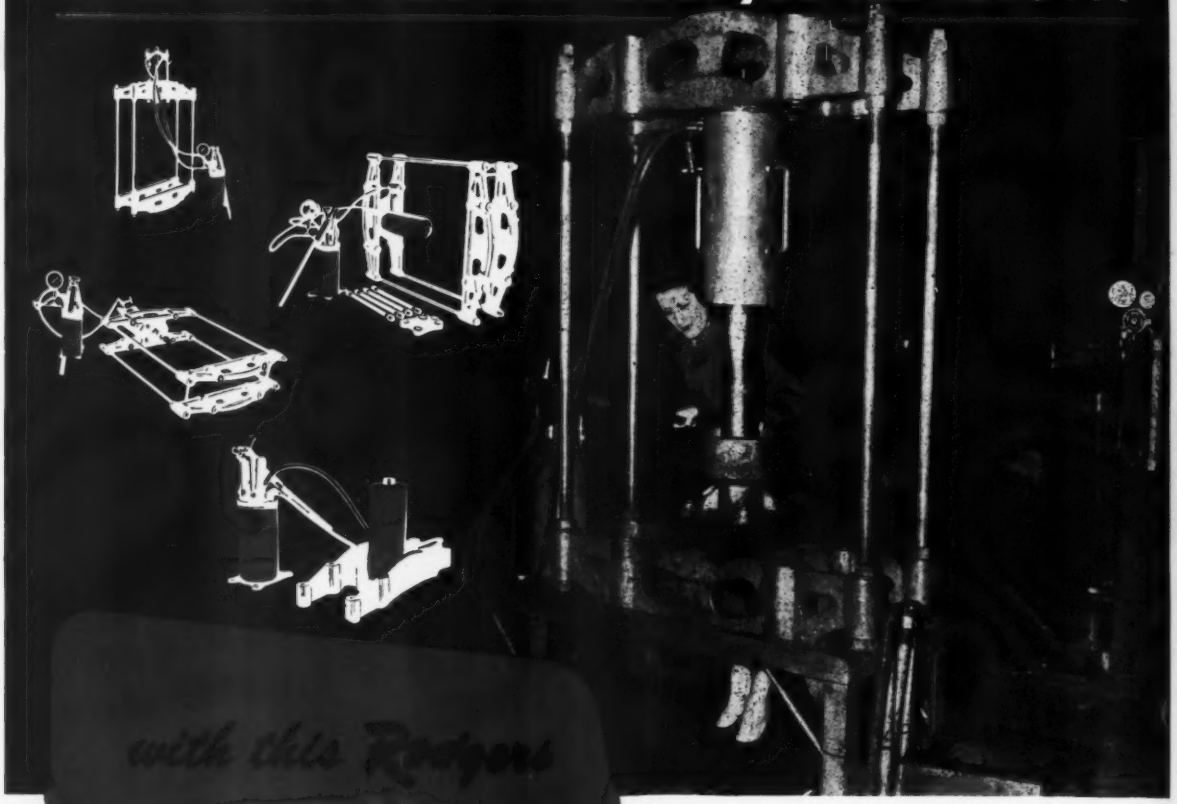
LETOURNEAU
PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

JOB-PROVED
Over 3600 Built and Shipped

TOURNAPULLS*

*Trade Mark Reg. U.S. Pat. Off.

think of the time and labor you can save . . .



with this Rodgers

portable hydraulic press of 100 uses . . .

Here is the handiest time-and-trouble-saving piece of equipment you can have around for maintenance, service and special jobs—any place that you may need 50 to 200 tons of easily portable hydraulic power.

The Rodgers Universal Press is the ideal answer for pulling gears, pinions and wheels: for pressing shafts, bushings and pins; for clamping and jacking operations. It is used on a stand as an ordinary press, or on its side horizontally. Tie rods are quickly disassembled to fit the press around a large piece of equipment and they may be lengthened with extension rods. Frame may be used in full or narrow width—cylinder is mounted either between upper frame members or suspended below. Tested special alloy steel assures great strength for safety and ruggedness. Power is supplied by either the Rodgers 4-speed Hand Pump or power-operated pump unit.

A Rodgers Universal will pay for itself over and over in the time and labor it will save you—we believe you will find it almost indispensable. *Write now* and let us send you all of the facts.

Send for this interesting booklet . . .

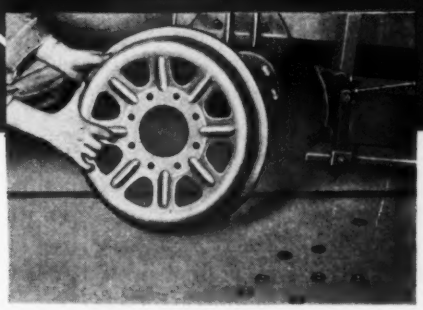
It will give you complete information and details about Rodgers Hydraulic Presses. No obligation, of course, and you can profit by it.

Rodgers Hydraulic, Inc.

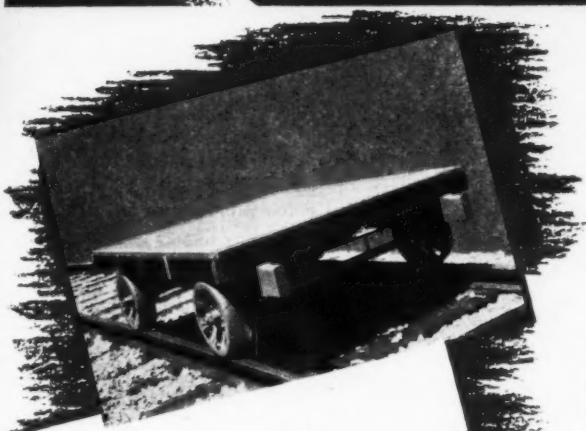
hydraulic power equipment

7458 Walker St., St. Louis Park, Minneapolis 16, Minn.

BUY BUDA DEMOUNTABLE Wheels



Tires quickly replaced in the field by one man.



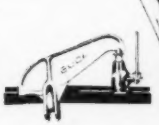
PUSH CARS

BUDA Model No. 6½ Push Car Wood frame type of 5 ton capacity. Deck size for 4'8½" gauge: 6'11" x 5'7". Weight approximately 650 lbs.

BUDA demountable pressed steel wheels are cold-formed from steel plate of uniform thickness for tough, long-term service. They can be quickly changed by one man on the road without the aid of special tools. Tires are interchangeable on hubs with all A.R.E.A. standard wheels.

All BUDA wheels, both demountable and standard riveted type, conform to A.R.E.A. standards. Write or wire for illustrated bulletins.

Motor Cars



Rail Benders

BUDA

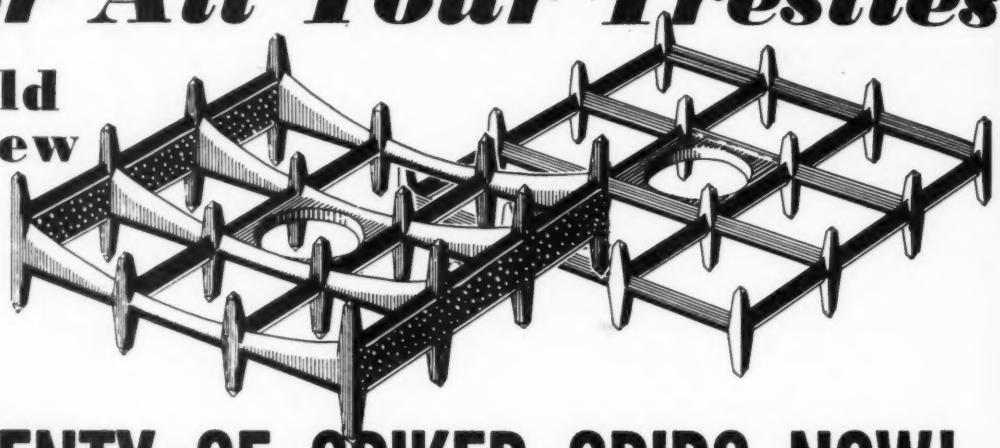
Track Liners

Track Drills

15403 Commercial Avenue
HARVEY (Chicago Suburb) **ILLINOIS**

For All Your Trestles

...old or new



PLENTY OF SPIKED GRIDS NOW!

TECO spiked grids, both curved and flat, for bracing joints of bridges, trestles and wharves are now available for immediate shipment.

You can now specify TECO Grids in your standard plans and be assured of quick delivery. Installed at critical points in a trestle, the Grids will give the structure a marked increase in rigidity even with today's heavier and faster-moving rail traffic.

During the War years when maintenance was curtailed and the use of materials restricted, some railway trestles were repaired by merely reinforcing the joints with spiked grids which effectively increased the rigidity of old structures. Ineffective bolt bracing with enlarged holes was corrected by the installation of Grids because the snug-fitting connectors transferred the load from one member to another distributing the stress over a much larger cross-section of the wood.

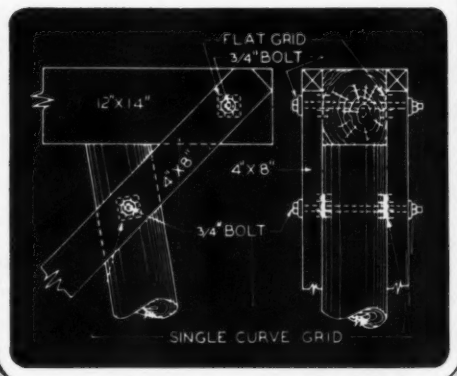
Specify TECO SPIKED GRIDS for your trestle bracing.

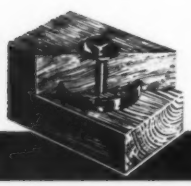
Watch for Announcement of New Booklet "Timber Connectors for Timber Construction in Railroad Service."

The Engineering Departments of Fifteen Class 1 Railroads have already used TECO SPIKED GRIDS for trestle bracing.

They are now specified in the standard plans for timber structures by many leading Roads. The recommended trestle designs of the A.R.E.A. show the grid as a typical connecting device for properly framed trestles.

The section below showing the use of the grids in bracing is from a recommended design of the A.R.E.A.



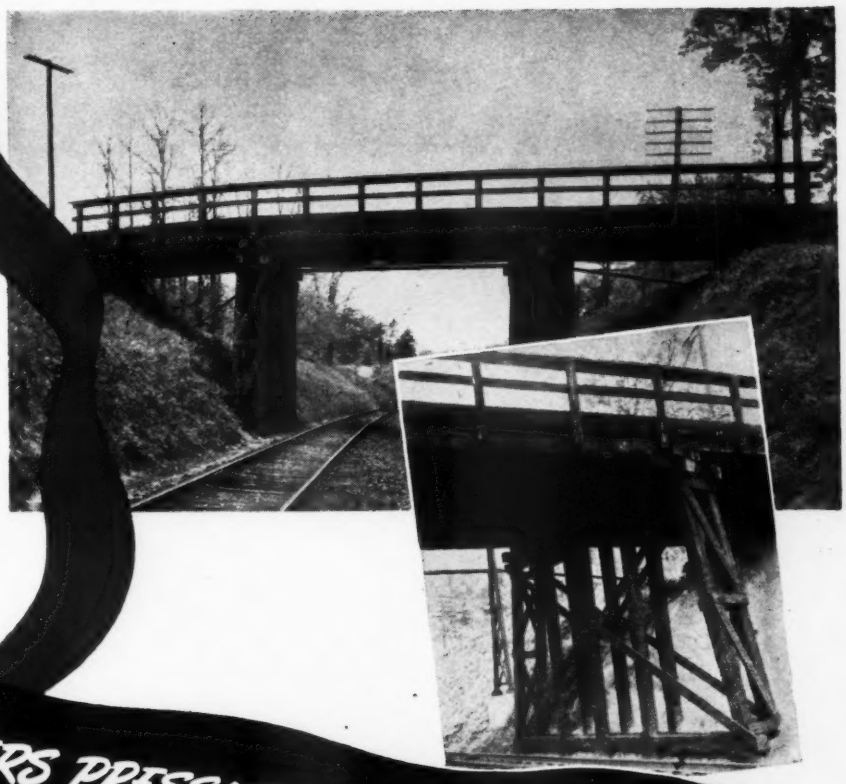


Timber Engineering Co., Inc. of Washington, D. C.

Washington • Chicago • New Orleans • San Francisco

SPECIFY TECO CONNECTORS • SPLIT RINGS • SHEAR PLATES • GROOVING TOOLS

There's an idea here For YOUR BRIDGE PROGRAM



KOPPERS PRESSURE-TREATED WOOD

This bridge illustrates the method that a number of engineers are using to take care of overpass requirements at maximum speed and minimum cost. The installation, which carries fairly heavy highway traffic, has a center main span of 33-ft. and two approach spans of 24-ft.; a 20-ft. driveway; and is built entirely of Koppers pressure-treated wood assembled with ring connectors and double-grip spikes. Stringers were framed to establish the vertical curve. A laminated sub-floor carries a bituminous concrete surface.

The customer's comments are illuminating. He wrote, "These bridges are capable of carrying heavy modern traffic, are comparatively cheap in first cost and we believe that they will be very economical to maintain. . . . They present a very neat appearance and for anything other than primary highways I feel that they represent a very desirable type of design for overhead highway bridges. . . . With this design the structure can be changed to any dimensions desired."

We are equipped to pre-frame bridge members to your blueprints prior to treating, so that little or no cutting is required on the job. Ask for details and estimates.

KOPPERS COMPANY, INC.—WOOD PRESERVING DIVISION

PITTSBURGH 19, PA.

KOPPERS

Buy Victory Bonds— and Keep Them!

THE INDUSTRY THAT SERVES ALL INDUSTRY

For ADEQUATE, UNIFORM Track Bolt Tension

Verona *Fixed Tension* Triflex Springs

SINCE 1873

WOODINGS-VERONA TOOL WORKS, VERONA, PA.

SINCE 1873

Can the life of steel products really be increased by 4 to 1?

"SOUNDS impossible," you say? Well, before Pearl Harbor you would have been right.

Then something happened. A startling discovery that means you may soon be able to buy washing machines, automobiles, hardware, *many* important metal items that can outlast any you've ever owned before by 4 to 1!

The discovery is CORRONIZING, a miraculous new weapon against corrosion and rust. Invented by scientists of the Standard Steel Spring Company, CORRONIZING is a new alloy "armor" that *far outlasts other rust-resisting coatings for steel.*

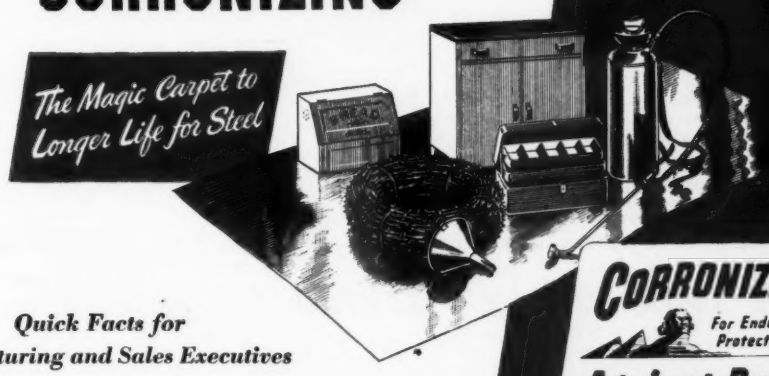
This is no mere claim. It has been proved in the war, on land and sea in every kind of climate. Progressive manufacturers and retailers will soon be able to bring you products made with "Corronized" steel. Motor car makers—always a step ahead—may be among the first to offer this sensational advantage.

So watch for the wonderful new products that will be made with "Corronized" steel. They can defy rust ... keep their beauty and safety years longer ... increase the service you get for your money as much as 4 to 1.

Standard Steel Spring Co.

ORIGINATORS OF

CORRONIZING

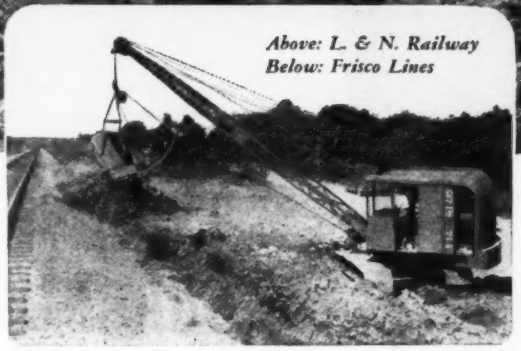


Quick Facts for Manufacturing and Sales Executives

Do not confuse CORRONIZING with other metal coatings. This patented process provides a permanent alloy "armor" with 5 layers of defense against corrosion! It becomes part of the steel base ... can be worked in any manner. Permits using lighter materials by prolonging steel's period of greatest strength. Write for samples and complete information.

STANDARD STEEL SPRING COMPANY
CORAOPOLIS, PENNSYLVANIA

Now... THE GREAT NEW LORAIN "41" SERIES!



Above: L. & N. Railway
Below: Frisco Lines

Every one of these four new performers—the Lorain 41 Crawler, the Moto-Crane 414, the Moto-Crane 416, and the Self-Propelled Crane 414—has its own long list of great features. Any one of these machines is good news by itself. But Thew now gives you all of them at once—so you may have the one that's best in mounting, boom equipment, speed and basic efficiency for your job. The two-speed, chain drive crawler, for example, gives you ¾ MPH and 1⅜ MPH. The rubber-tired, single-engined, Self-Propelled Crane offers four speeds to 7 MPH. The two rubber-tired Moto-Cranes—two-engined—four or six wheel drive—give you fastest mobility of all, up to 30 MPH.

Here are just a few things you'll like in the new Lorains! Entire 2-speed chain-drive crawler mounting is wider, longer, heavier with new, positive 4-way ratchet and pawl tread and travel lock.

A brand new shoe type swing clutch that gives far smoother action and many times the usual service life. Greatly increased capacities (ask for the new ratings.) ¾-yd. chain crowd shovel. Dual boom stop on all crane booms . . . a double safety feature.

Two piece, all-welded, pin-connected, fast-assembly boom interchangeable for all crane, clam and drag work. All machines convertible to shovel, crane, clamshell, dragline and backhoe work. All available with gas, diesel or electric power.

As soon as you see these new Lorains in action, you'll want to put one to work! Check the features and capacities we have room to give you here—then see your nearest Lorain Distributor for the complete facts!

THE THEW SHOVEL COMPANY • LORAIN, OHIO

SEE YOUR LORAIN DISTRIBUTOR NOW!

The new rubber-tired Moto-Crane 416

The new rubber-tired Self-Propelled Crane 414

Reg. Trade Mark

thew-Lorain

CRANES • SHOVELS • DRAGLINES • MOTO-CRANES

IN BOISE THEY DRIVE OVER THE PUMP HOUSE

A BYRON JACKSON SUBMERSIBLE MAKES THIS POSSIBLE

Primary water sources, heretofore unavailable, are now easily usable, regardless of location. Byron Jackson Submersibles are being installed under lawns, at street intersections, in alley and parkways, under airport runways or in river beds. No pump house is needed, obstructions are not created and noise is eliminated.

In Boise, Idaho, a Submersible was installed at a 30° street intersection, the pump being located just off the apex of the property line and on the street. Discharge elbow and well seal rest on the floor of the sump, about seven feet below the pavement. This Submersible has been in constant operation since installation, delivering 950 gpm against a total head of 240 feet. Current for the submerged motor is supplied by an armored marine type cable to switch panel on power line pole.

Available in sizes from 5 to 350 hp, capacities to 10,000 gpm and over can be handled. Diameter of largest motor is only 15¾".

If your water source is difficult of access; if pump house would obstruct or prove unsightly; if noise abatement is essential; if elimination of attendants and maintenance is desirable, let us plan a Submersible installation to meet your particular need.

BYRON JACKSON CO.

Houston • LOS ANGELES • New York

Made for WORKING ON THE RAILROAD
ALL THE LIVE-LONG DAY!
WOOD
BRAND
TRACK
SHOVEL
. . . WITH
ALLEABLE D HANDLE
AND
STEEL I-BEAM
HANDLE REINFORCEMENT
WOOD SHOVEL AND TOOL CO. PIQUA OHIO
A NATIONAL ORGANIZATION SPECIALIZING EXCLUSIVELY
IN SHOVELS, SPADES AND SCOOPS

Uniformity of Chemical Composition

. . . another real reason why RED LEAD means Extra Protection against Rust

Red Lead's outstanding uniformity of performance results not only from its extreme purity but also from its precise chemical composition . . . lead orthoplumbate. This makes for predictable chemical behavior.

For many years Red Lead has been the standard among metal protective paints because of inherent fundamental properties of the pigment itself.

Among the most important of these is Red Lead's definite chemical composition and uniformity—as distinguished from pigments which have indefinite composition or vary from batch to batch, with resulting possibility of variation in performance.

One reason for this uniformity is that Red Lead is a simple chemical compound, being made from oxygen and high purity metallic lead. Consequently, Red Lead is an extremely pure compound. It contains no corrosion accelerating impurities such as water-soluble salts of chlorides or sulfates.

Uniform composition means dependable performance, day after day, job after job.

Furthermore, Red Lead has the property of counteracting acid conditions, recognized as accelerators of rust. In the presence of various acids, Red Lead forms insoluble neutral lead salts at the approximate rate at which the acids are supplied. This is true whether the acids originate from acid forming environments, such as gas, smoke and moisture in the atmosphere, or from the decomposition of the vehicle. Thus, a rust inhibiting condition is maintained with a Red Lead paint.

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify RED LEAD for All Metal Protective Paints

The value of Red Lead as a rust preventive is most fully realized in a paint where it is the only pigment used. However, its rust-resistant properties are so pronounced that it also improves any multiple pigment paint. No matter what price you pay, you'll get a better paint for surface protection of metal, if it contains Red Lead.

Write for New Booklet

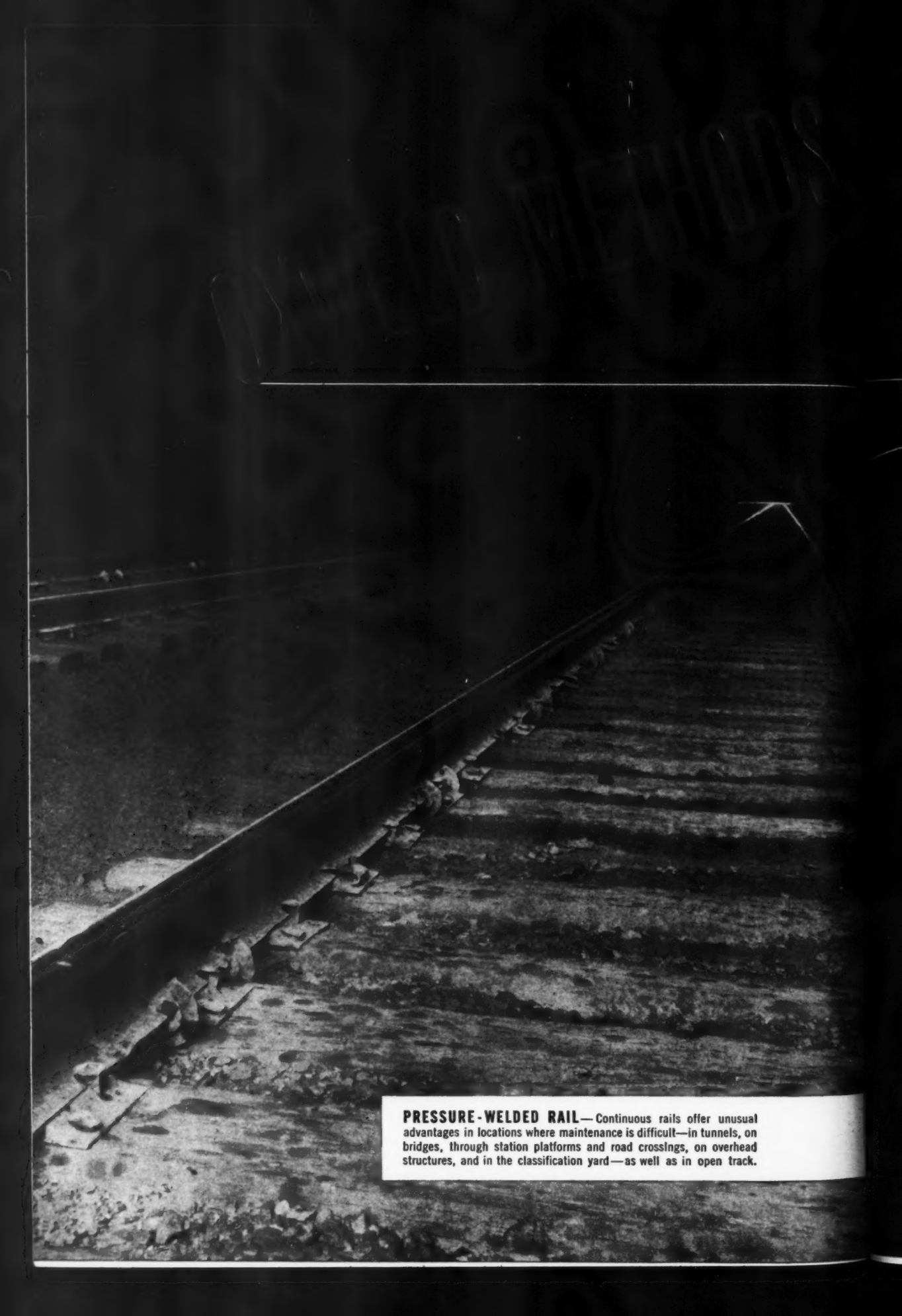
"Red Lead in Corrosion Resistant Paints" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior protection. It also includes typical specification formulas. If you haven't received your copy, address nearest branch listed below.

* * *

The benefit of our extensive experience with metal protective paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 80, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna.); Philadelphia 7 (John T. Lewis & Bros. Co.)

DUTCH BOY RED LEAD



PRESSURE-WELDED RAIL—Continuous rails offer unusual advantages in locations where maintenance is difficult—in tunnels, on bridges, through station platforms and road crossings, on overhead structures, and in the classification yard—as well as in open track.

PRESSURE-WELDED RAIL

FLAME-HARDENED RAIL ENDS

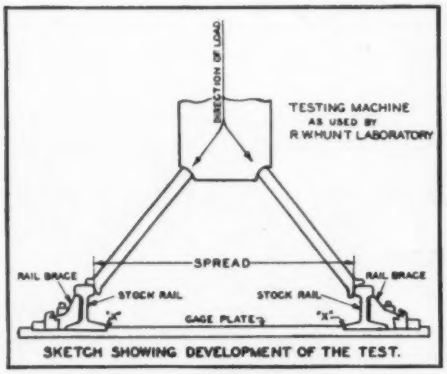
FLAME-STRAIGHTENED JOINT BARS

BUILT-UP RAIL ENDS

MORDEN

SECURITY ADJUSTABLE RAIL BRACE

—IN SERVICE ON MAJOR RAILROADS SINCE 1920—



SKETCH SHOWING DEVELOPMENT OF THE TEST.

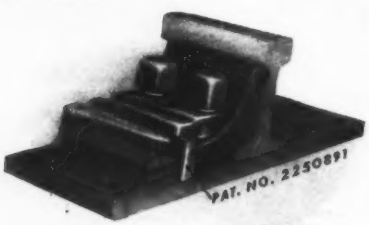
SUPER-STRENGTH AT DANGER SPOTS

Modern high speed operation under heavy traffic throws added stresses on road beds. The Morden Security Adjustable Rail Brace provides that added security at vital spots which is so important in meeting the strain of present railway operating conditions.

The Morden Brace is especially suited for split switches and slip switches in interlocked territory where stock rails must be kept to proper gage and alinement. The simple design of the Brace makes it easy to install, adjust or remove without disturbing either the rail, tie or plate.

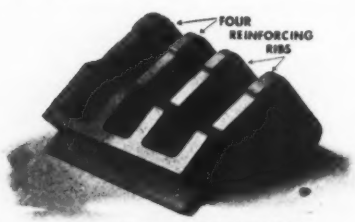
Under concentrated and comprehensive loading tests, the Morden Brace supported a weight of 50,000 lbs. at a 45 deg. angle with a spread of only 1/8 in., and with a raise in weight to 200,000 lbs., the spread was only one inch.

Pioneering in the design and production of frogs, switches, crossings, guard rails, gage rods, rail braces and security track designs, Morden has supplied the railroad industry with quality equipment for over 60 years. Our engineers are always available to help you with track maintenance problems.



COMPLETE BRACE ASSEMBLY

INDIVIDUAL BRACE PARTS



UNDERSIDE OF BRACE

Four reinforcing vertical ribs, which extend from rail web to floor of brace plate, afford the greatest possible structural strength to the design.

MORDEN

FROG and CROSSING WORKS

CHICAGO, ILL.

Representatives in: CLEVELAND, OHIO; NEW ORLEANS, LA.; LOUISVILLE, KY.; ST. LOUIS, MO.; WASHINGTON, D. C.

SURFACING TIME CUT 50-60%

by

AIR TAMPING UNITS

This means that a group of men can surface *twice as much* track if they use compressed air power and air tampers. With the manpower shortage becoming more acute, here is a solution that warrants serious consideration.

Keep in mind that not only do you get twice as much track tamped—but it is more uniformly tamped and will last longer—ties are not slivered or split—water pockets are eliminated and a style of tamping bar is available for each type of ballast.

There are additional advantages to be gained by using I-R off-track compressors to supply the air power—pipelines are eliminated—traffic is not interrupted—they are extremely portable—they give uninterrupted service and will operate many combinations of air tools.

We will gladly assist in making a survey of your problems.

AIR TOOLS
COMPRESSORS
CONDENSERS
ROCK DRILLS
TURBO BLOWERS
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OIL AND GAS ENGINES

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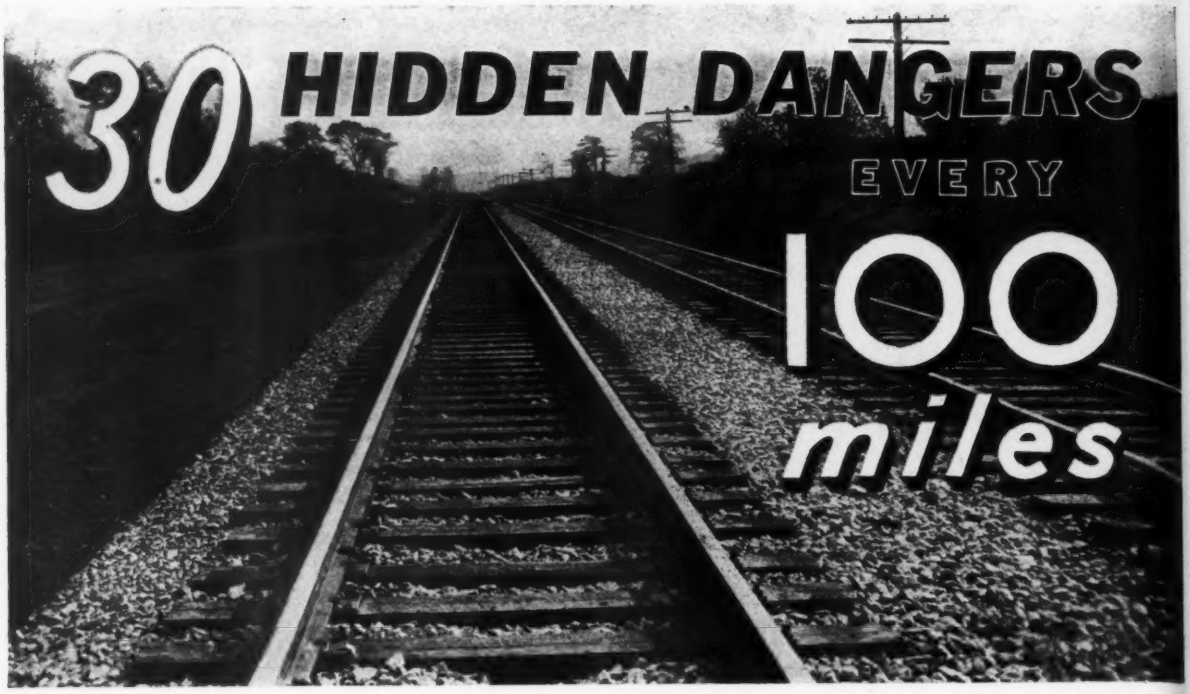


Over 50,000 Invisible Defects—*Potential Rail Failures*—Discovered Annually by SPERRY RAIL SERVICE

THESE defective rails, if they had been left in track, might have caused many serious accidents. Sperry's continued research and the many improvements to the famous yellow fleet of Detector Cars operated by Sperry Rail Service, have definitely contributed to the safer handling of the greatest volume of freight and passenger traffic in history.

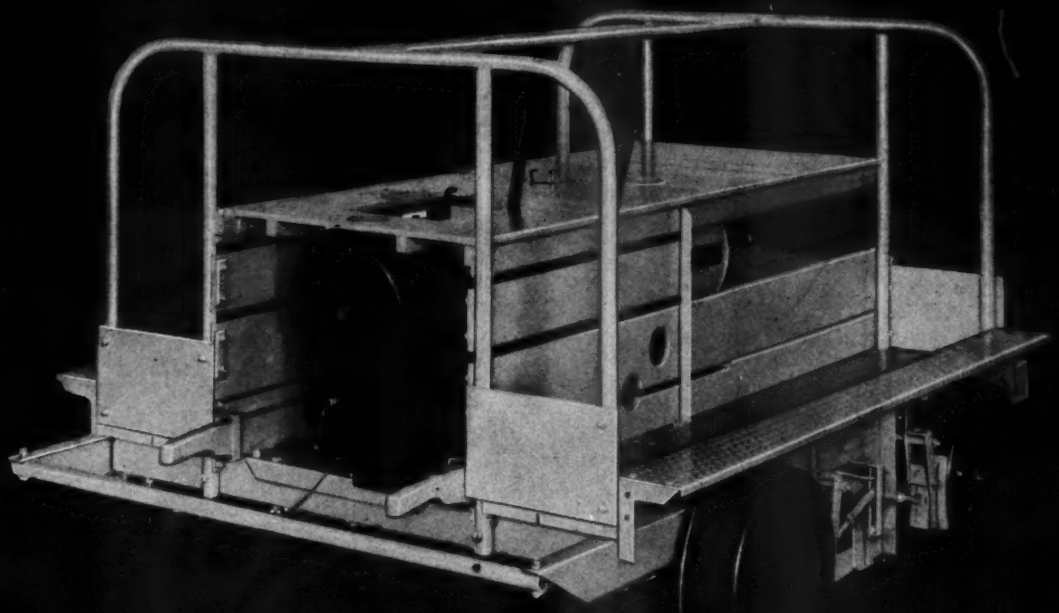
Sperry Rail Service regularly tests track on more than 80 railroads in the U. S. A. and Canada.

SPERRY *Rail Service*

HOBOKEN, NEW JERSEY — CHICAGO, ILLINOIS

FAIRBANKS-MORSE MOTOR CARS

"First on the rails and still first"



SHEFFIELD MOTOR CAR No. 53

A sturdy lightweight Section Car—only 930 pounds. Room for eight men, with tools, yet one man can handle it. Rear-lifting weight is only 130 pounds. Used in large numbers by some of the best railroads in America. Safe, economical, and versatile. Chain drive, 8- to 13-hp. motor. For details on this or other Fairbanks-Morse Motor Cars write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

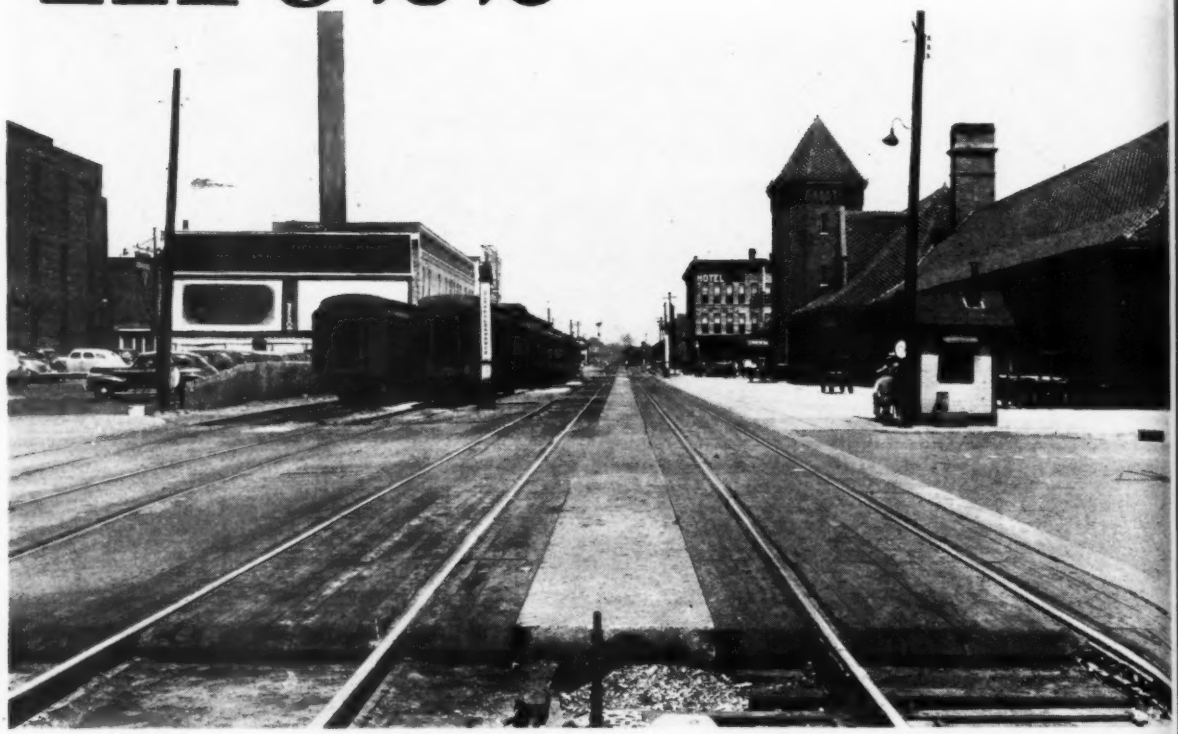
Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps
Scales • Magnetos • Railroad Motor Cars, Standpipes, and Coaling Stations

MOSS crossings give satisfaction

View of MOSS Crossing installed in 1944 at Alton Station in Springfield, Illinois.



MOSS Ready-Made Sectional Highway Crossings give satisfaction to the railroad and to the motorist. To the motorist because of a smooth ride over the railroad tracks. To the railroad because of long life, low cost, ease of installation and minimum of maintenance expenses.

MOSS Ready-Made Sectional Highway Crossings are made of sturdy, Black-Gum, 8-foot sections. The sections are pre-framed, dressed to even thickness and width, trimmed to length, ends bevelled, securely bolted together and pressure-treated with creosote. A small track gang with their regular tools can easily install MOSS Crossings.

MOSS Ready-Made Sectional Highway Crossings have seen 12 to 14 years' service at numerous locations of dense truck traffic and are today in practically as good condition as the day they were installed.

Lightweight | **Easy To Install** | **Sturdy**

Long Life | **Low Cost**

SEND FOR DESCRIPTIVE CIRCULAR TODAY

CROSS TIES
SWITCH TIES
POLES & POSTS
PILING
CROSSINGS

T. J. MOSS TIE COMPANY

The Stamp of Character MC
FOUNDED 1879

700 SECURITY BUILDING ST. LOUIS, MISSOURI

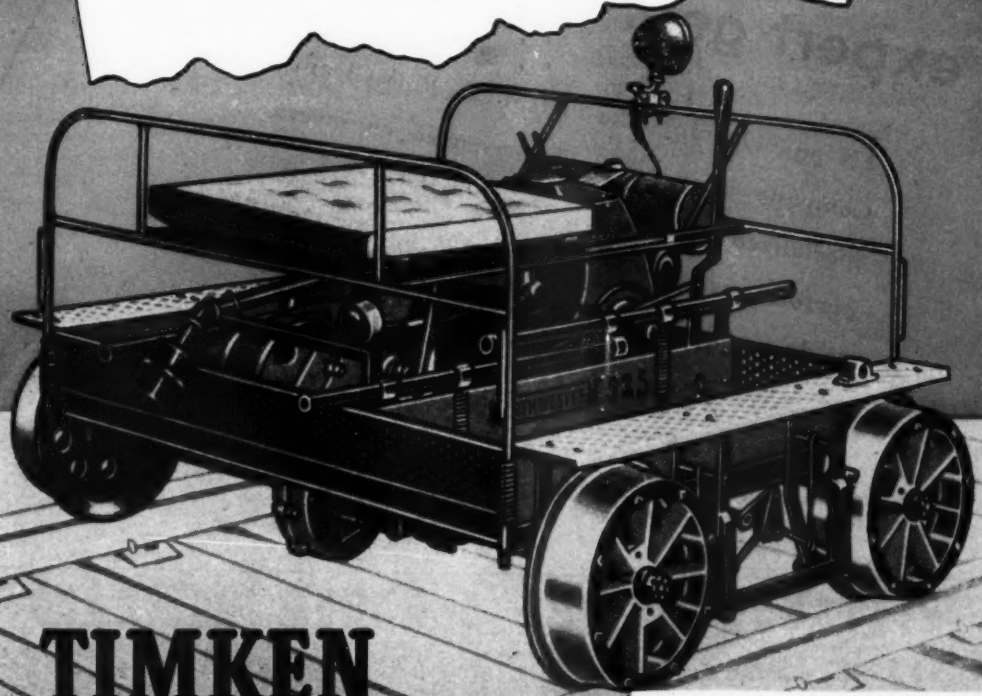
WOOD PRESERVING PLANTS
MT. VERNON, ILL.
EAST ST. LOUIS, ILL.
GRANVILLE, WIS.
SHREVEPORT, LA.
COLUMBUS, MISS.

GREATER AVAILABILITY FOR SERVICE

Timken Bearing Equipped

You can always depend on Timken Bearing Equipped section motor cars and trailers to be ready for instant action when needed, for besides making cars run smoother and enabling them to go faster, Timken Bearings help keep them out of the repair shop by eliminating wear on axles; preserving wheel gauge; and preventing wheel breakage. They also carry radial, thrust and combined loads with a substantial margin of safety and hold moving parts in correct relationship under all operating conditions.

Specify Timken Tapered Roller Bearings and insist on the trade-mark "TIMKEN" being on every bearing that goes in your equipment. The Timken Roller Bearing Company, Canton 6, Ohio.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Northwestern 535 One-man Inspection Car equipped with Timken Bearings on all axles. Made by Northwestern Motor Co., Eau Claire, Wisconsin.

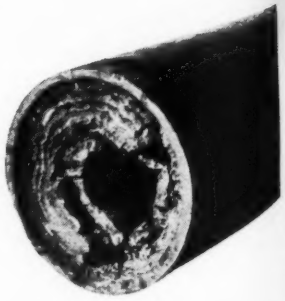
IN MATTERS LEGAL

and in pipe cleaning

An expert gets the best results!

IN pipe cleaning, the Pittsburgh Pipe Cleaner Company is expert. Experienced engineers, specialized tools and years of satisfactory job performance provide us with the "know how" to do a real pipe cleaning job.

Send for information concerning our complete contract pipe cleaning service.



PITTSBURGH PIPE CLEANER COMPANY

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PITTSBURGH, PHILADELPHIA, BALTIMORE, WASHINGTON.
NEW YORK, BUFFALO, CHICAGO, CINCINNATI, ST. LOUIS, DETROIT

A New Line of Forged Adjustable Rail Braces

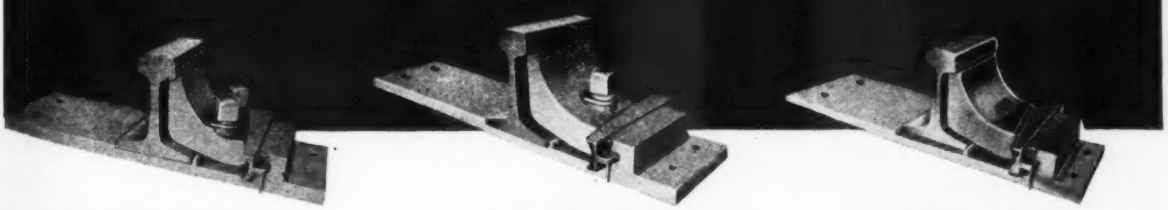
PRESENTED BY

PETTIBONE MULLIKEN CORPORATION

. . THE RESULT OF SUGGESTIONS FROM RAILROAD MAINTENANCE OF WAY AND SIGNAL DEPARTMENTS

Maximum Bracing—Minimum Maintenance—Longer Service Life

PETTIBONE MULLIKEN design (1) Reduces the need for full rigid clamping. (2) Supplies constant bracing to the rail whether bolts are tight or loose or whether no bolts are used. (3) Controlled flexibility—not attempting to stop the wave or up-and-down motion of the rail, yet restricting tipping or side-thrust—no wide gage—close signal adjustments. (4) Provides larger, better fitting wearing areas of forged, corrosion resistant steel, thus reducing the frequency of adjustment. (5) Makes infrequent adjustment easy.



Two Bolt Brace

Bolts will be initially tighter and will stay tight longer than on other bolted braces. Maintains gage and is an effective brace to the rail even if bolts work loose. Square-head acorn nuts spaced for 180° turn with ordinary track wrench. 11 pieces—easy to install, adjust or remove.

One Bolt Brace

Bolt will be initially tighter than on other braces. Single bolt acts as a pivot under rocking motion caused by change of wheel weight from receiving to leaving edges of plate—tends to remain tight longer. Maintains gage and is an effective brace to rail even if bolt works loose. Square-head acorn nut permits 180° turn with ordinary track wrench. 8 pieces—easy to install, adjust or remove.

Boltless Brace

No bolts to corrode, wear or tighten. Controlled flexibility—up and down or wave motion of rail is not limited, yet restricts its tipping or side-thrust. Maintains gage, and permits accurate signal adjustments. Simplicity assures proper maintenance. Design permits single or double spiking on outside of stock rail if desired. 4 pieces—wedge, brace, key and plate.

Write for Bulletin No. 1101

"Quality Since 1880"

PETTIBONE MULLIKEN CORPORATION

4710 West Division Street, Chicago 51, Illinois

MAKING YOUR WISHES COME TRUE . . .

One wish has been fulfilled. Won by 3½ years of deadly struggle. With God's help, we have prevailed.

Now we have a chance to make another wish come true. For most of us, the outlook is a bright one. If we will simply use the brains, the will, the energy, the enterprise . . . the materials and resources . . . with which we won our war, we can't fail to win the peace and to make this the richest, happiest land the world has known.

Your wishes have been wrapped in that bright outlook. Your wish for a cottage by a lake. For your boy's college education. For a trip you long to take. For a "cushion" against emergencies and unforeseen needs.

You can make those wishes come true by buying bonds today . . . buying them regularly . . . and holding on to them in spite of all temptation.

There's no safer, surer investment in the world. You can count on getting back $4 for every $3 you put in—as surely as you can count on being a day older tomorrow.

So why not be patriotic and smart at the same time?

FULFILL YOUR WISH—BUY EXTRA BONDS IN THE GREAT VICTORY LOAN!

Railway Engineering and Maintenance

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

WINNING THE TIE-TAMPING RACE

Maintenance men who drive these Blue Brute Track Teams keep roadbeds in shape for heavy travel . . . faster and more economically . . . because Blue Brutes make tie-tamping easier.

Lift a WTT-7 Blue Brute Tie Tamper and you'll see why. It's light and perfectly balanced, yet for ruggedness and power, no other tamper can beat it. Hook up four of these feather-weights to a light, compact, maneuverable Blue Brute Hand-I-Air Compressor . . . turn on their leak-proof throttles and see what 60 cubic feet of air per minute can do in lineal feet of finished surfacing per day. That air, flowing smoothly through light, tight, quiet, efficient Feather* Valves, costs less . . . does more. A trial will convince you.

Also working on the railroad these days are such other Blue Brute Track Teams as: portable gasoline, Diesel and electric-driven compressors and rail-car compressors teamed up with rock drills, trench diggers, backfill tampers . . . all famous for making less air do more work. Investigate them further to see why *there's more worth in Worthington.*

*Reg. U. S. Pat. Off.

H 5-10

Behind the Fighting Fronts with BLUE BRUTES

Busy railroad men repairing the war-damaged arteries that feed victorious armies and liberated peoples rely on the same Blue Brute Track Teams that are helping railroads here at home deliver the goods on schedule.

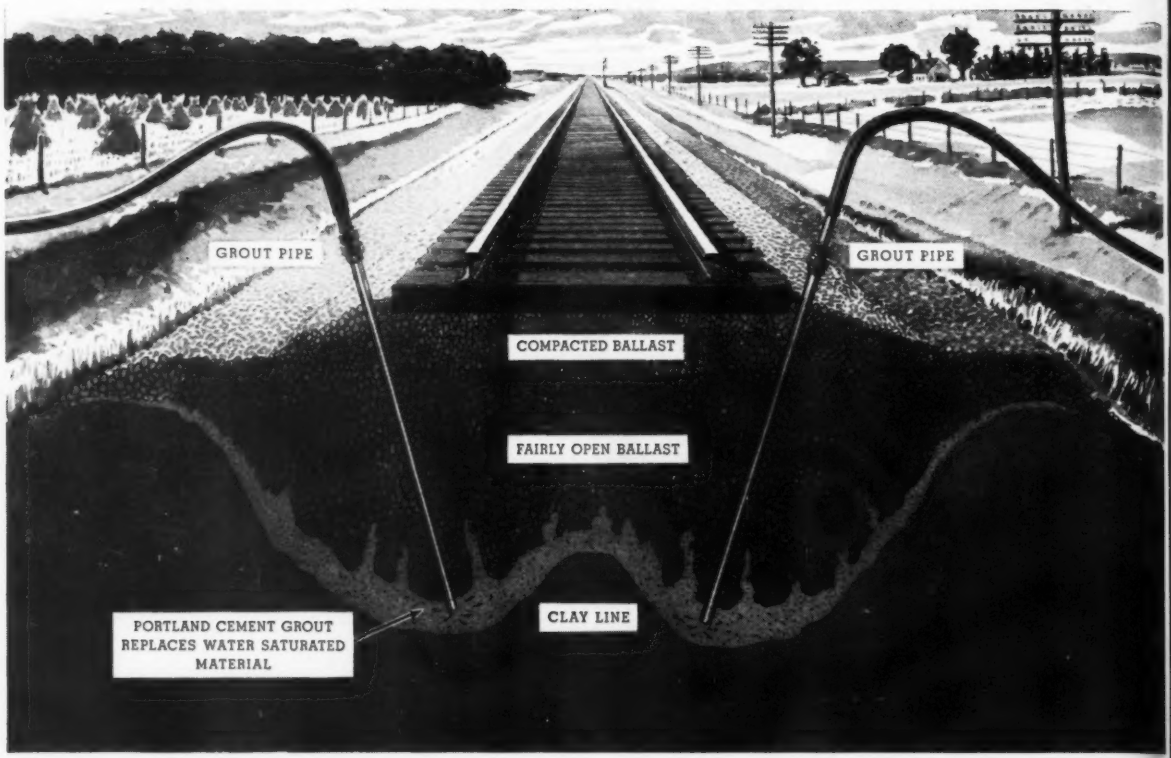
Get more **WORTH** *from air with* **WORTHINGTON**

BUY BLUE BRUTES

Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division Holyoke, Mass.



PRESSURE GROUTING

saves thousands of dollars

—pays own cost in a few months

Savings of thousands of dollars in maintenance, smoother riding track, and elimination of slow orders have resulted from pressure grouting of subballast on major railroads.

More than twenty major railroads are now using this simple, positive method of eliminating water pockets or soft spots and increasing the load-carrying capacity of troublesome subgrades.

In nearly every instance where pressure grouting with portland cement has been tried, the entire cost has been returned within a few months by savings in maintenance.

Write for copy of *"Stabilizing Railroad Track by Pressure Grouting."* Free in United States and Canada.

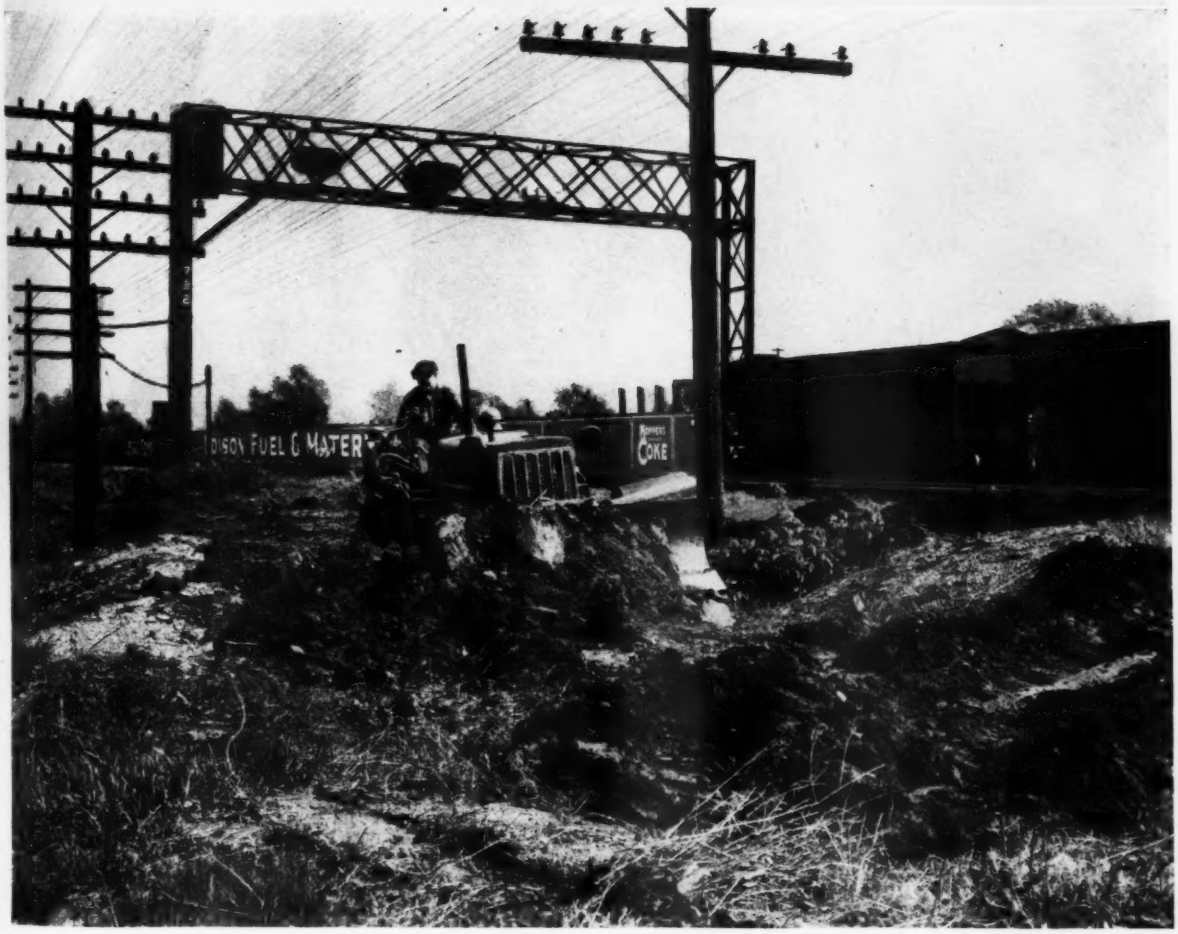
Portland Cement Association

Dept. A10-27, 33 W. Grand Ave., Chicago 10, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

BUY AND KEEP MORE VICTORY BONDS

YEAR-ROUND WORKER ON THE NORTHWESTERN



THE Chicago & Northwestern Railroad has found this "Caterpillar" Diesel D4 Tractor a mighty handy tool along the right-of-way.

In the open months of spring, summer and fall, it does all sorts of off-track maintenance work with its bulldozer and scraper—cleaning ditches, leveling banks, building shoulders and constructing new grades.

When winter snows come, the same sturdy machine, sure-footed and powerful in spite of its small size, keeps the concrete driveways cleared in the Northwestern's 20-track Wood Street Potato Yard. First it 'dozes the snow into a windrow, then removes it with a 3½-yard scraper. Last winter the "Caterpillar" Diesel was able to average 57 yards of wet snow per hour on a 500-foot haul—loading, dumping and return.

With fuel consumption of only about 1¼ gallons per hour, this tractor and its matched equipment save the time of off-track labor and work-train crews and do away entirely with traffic interruptions. Like every "Caterpillar" Diesel, it's built to stand up to the toughest jobs and worst extremes of heat, cold, mud and dust—built for long, trouble-free life and minimum upkeep cost.

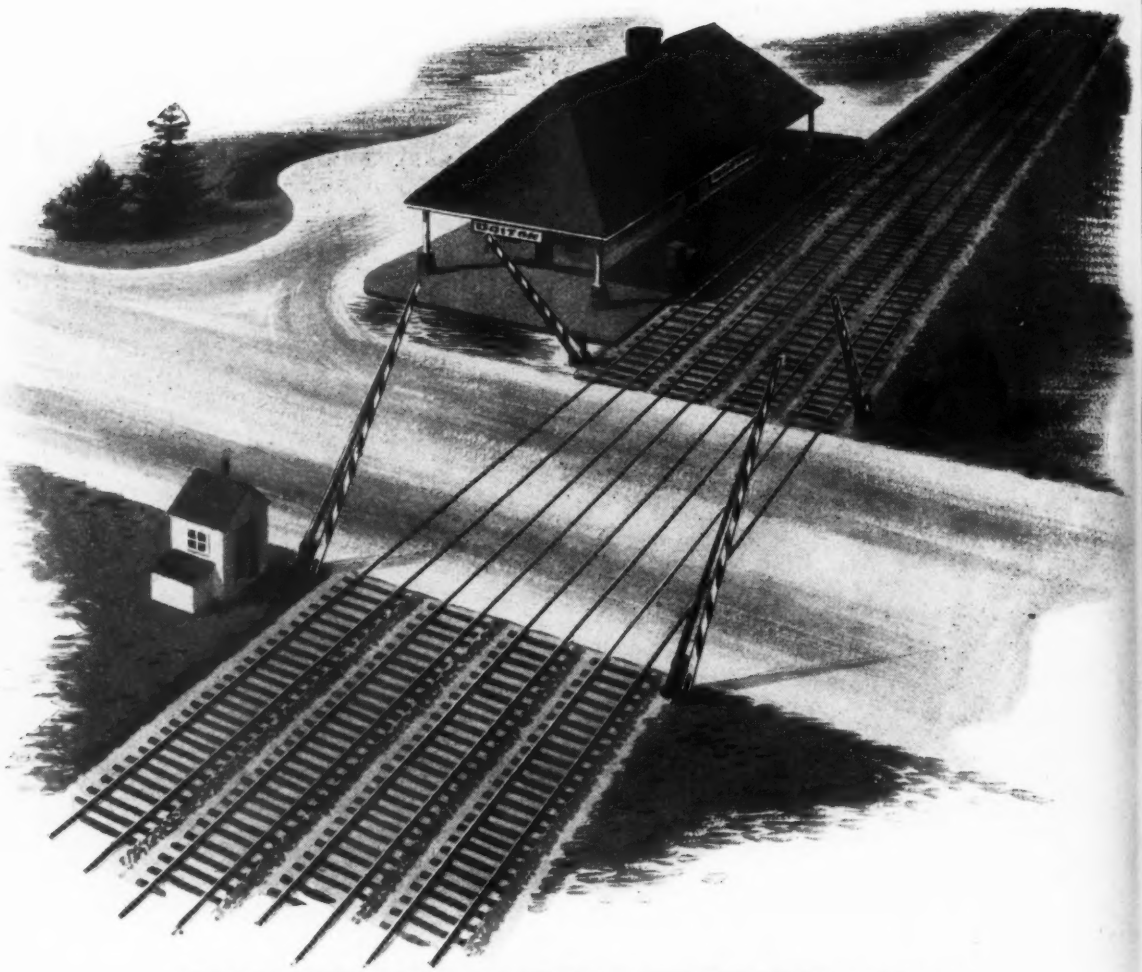
CATERPILLAR TRACTOR CO., Peoria, Ill.

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

The discharged veteran wears this emblem. Remember his service and honor him.



GET RID OF JOINT MAINTENANCE AT GRADE CROSSINGS

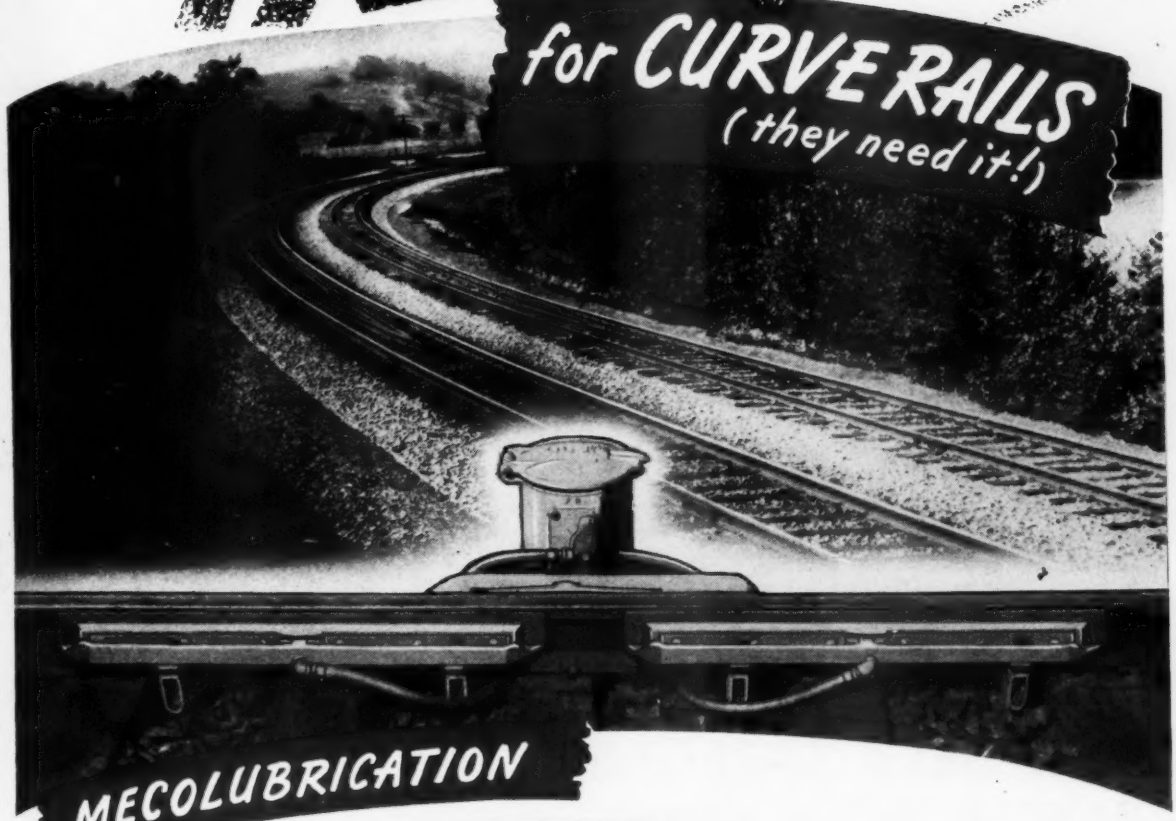
Why suffer the expense of repairing rail joints at grade crossings, paved streets, tunnels and other stretches where track maintenance is difficult?

Many railroads have found the answer in Thermit welding which converts the rail lengths into continuous track. They have used the process not only for these critical sections of track but for main line track as well, to eliminate joint maintenance, lengthen rail life and provide smoother operation of rolling stock.

Thermit welding is performed in four simple steps: lining up the rails, forming the molds, reacting the Thermit, cleaning and grinding the weld. The work can be done by your own crew after a brief period of instruction by Metal & Thermit supervisors. Metal & Thermit Corporation, 120 Broadway, New York 5, N. Y., Albany, Chicago, Pittsburgh, South San Francisco, Toronto.

Thermit Welding

HELP! for CURVE RAILS (they need it!)



MECOLUBRICATION

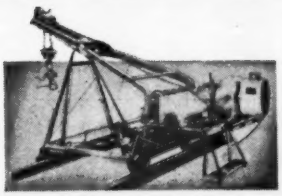
RESCUES Curve Rails

from Excessive FRICTION!

Meco-grease your curves now to take the "bite" out of curve friction. Mecolubrication makes curve rails last as long as tangent rails . . . prolongs life of present rails 2 to 4 times . . . then you can "let 'er lay" to protect the new rails when the time comes for relaying.

★ **Maintenance Equipment Company** ★

RAILWAY EXCHANGE BUILDING • CHICAGO, ILLINOIS



Power Rail Layer Requires No Train Orders

Mack Reversible Switch Point Protectors Make switch rails last 8 to 10 times longer

1052

"Off the Track"

MEANS "ON THE JOB"

with

LINK-BELT SPEEDER
CRAWLER "SHOVEL-CRANE"

Keep your equipment off the track and it works with least interference from—or with—traffic. Routine maintenance and construction, or emergency work, is handled to the best advantage with Link-Belt Speeder's mobile, crawler mounted machines.

Another important factor that keeps them "on the job" is their rugged construction, their ability to stand up under tough conditions, and the quick convertible feature, which permits the main power unit to function as shovel, dragline, clamshell, or crane, as needs arise. Your post-war construction and maintenance program should provide for Link-Belt Speeder equipment.

LS-120 Link-Belt Speeder dragline clearing miles of ditch, without interfering with regular train schedules.

Link-Belt Speeder Model K-370 Shovel working in 85 foot cut of solid rock.

LINK-BELT SPEEDER

Builders of the Most Complete Line of
SHOVELS-CRANES-DRAGLINES

LINK-BELT SPEEDER CORPORATION, 301 W. PERSHING ROAD, CHICAGO-9, ILL.
(A DIVISION OF LINK-BELT COMPANY)

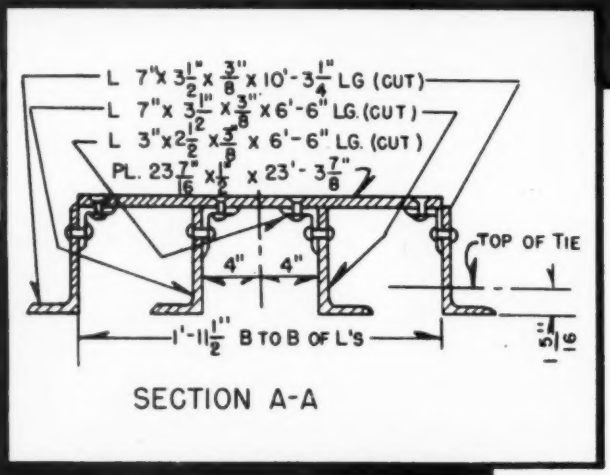
Big, Tough Jobs

WILLIAMS "SUPERECTOR"

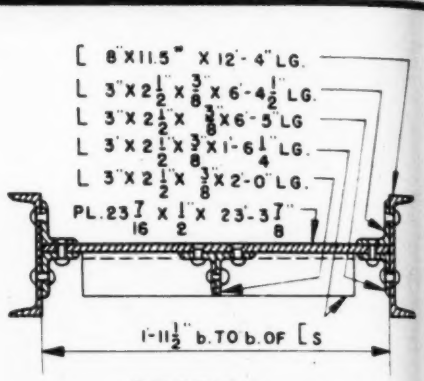
● This rugged, reversible ratchet wrench is designed for speed and power. Quadruple pawls, rather than a single pawl, combine with a drop-forged handle to give it unbelievable strength. Twenty teeth on all sockets—both hex and square—permit complete rotation of nuts with only 18° handle swing. Made in five brawny sizes up to 53" long, accommodating sockets with openings from 1" to 4-5/8". Sold by Industrial Distributors everywhere. J. H. Williams & Co., Buffalo 7, N. Y.

WILLIAMS
DROP-FORGINGS AND
DROP-FORGED TOOLS

When Morrison Creative E



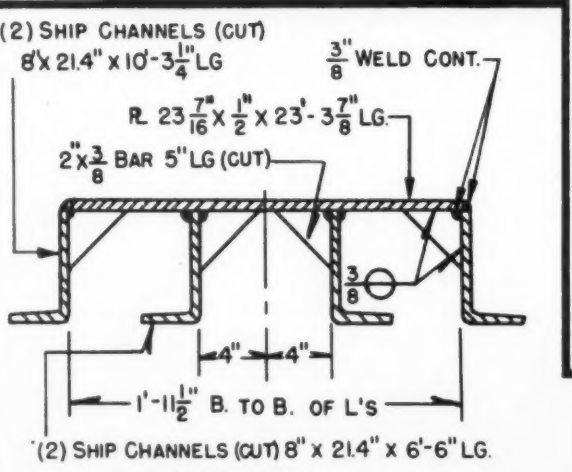
SECTION A-A



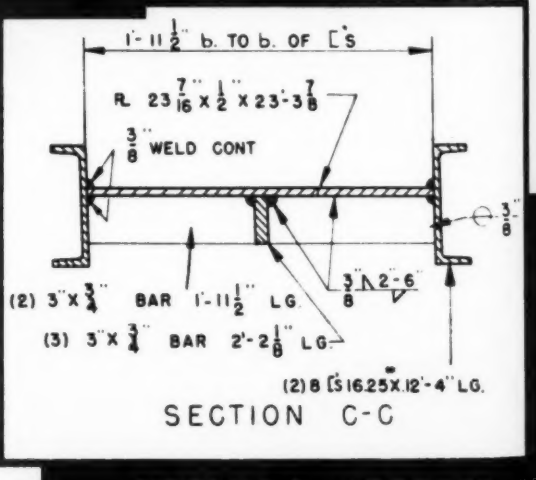
SECTION C-C

RIVETED DESIGN

This is a reproduction of a portion of the blueprints as they came to Morrison. Notice the numerous rivets . . . every one of which is an invitation to water seepage and consequent high maintenance costs. Compare this construction with that of the improved Morrison continuous-weld method shown below.


(2) SHIP CHANNELS (CUT)
8"X 21.4" X 10'-3¼" LG
⅜" WELD CONT.
PL 23 7/16" X ½" X 23'-3⅞" LG.
2"X⅜ BAR 5" LG (CUT)
⅜
4"
4"
1'-11½" B. TO B. OF L'S
(2) SHIP CHANNELS (CUT) 8" X 21.4" X 6'-6" LG.

SECTION A-A



SECTION C-C

WELDED DESIGN

This is the way Morrison Creative Engineering redesigned the track pan. Not a rivet anywhere. Lighter because all connecting angles and rivets necessary for riveted construction have been eliminated. Stronger because heavier plate sections and welded construction made for a solid one piece unit. Consider the savings in manufacturing costs where layout, punching and reaming of holes has been eliminated.

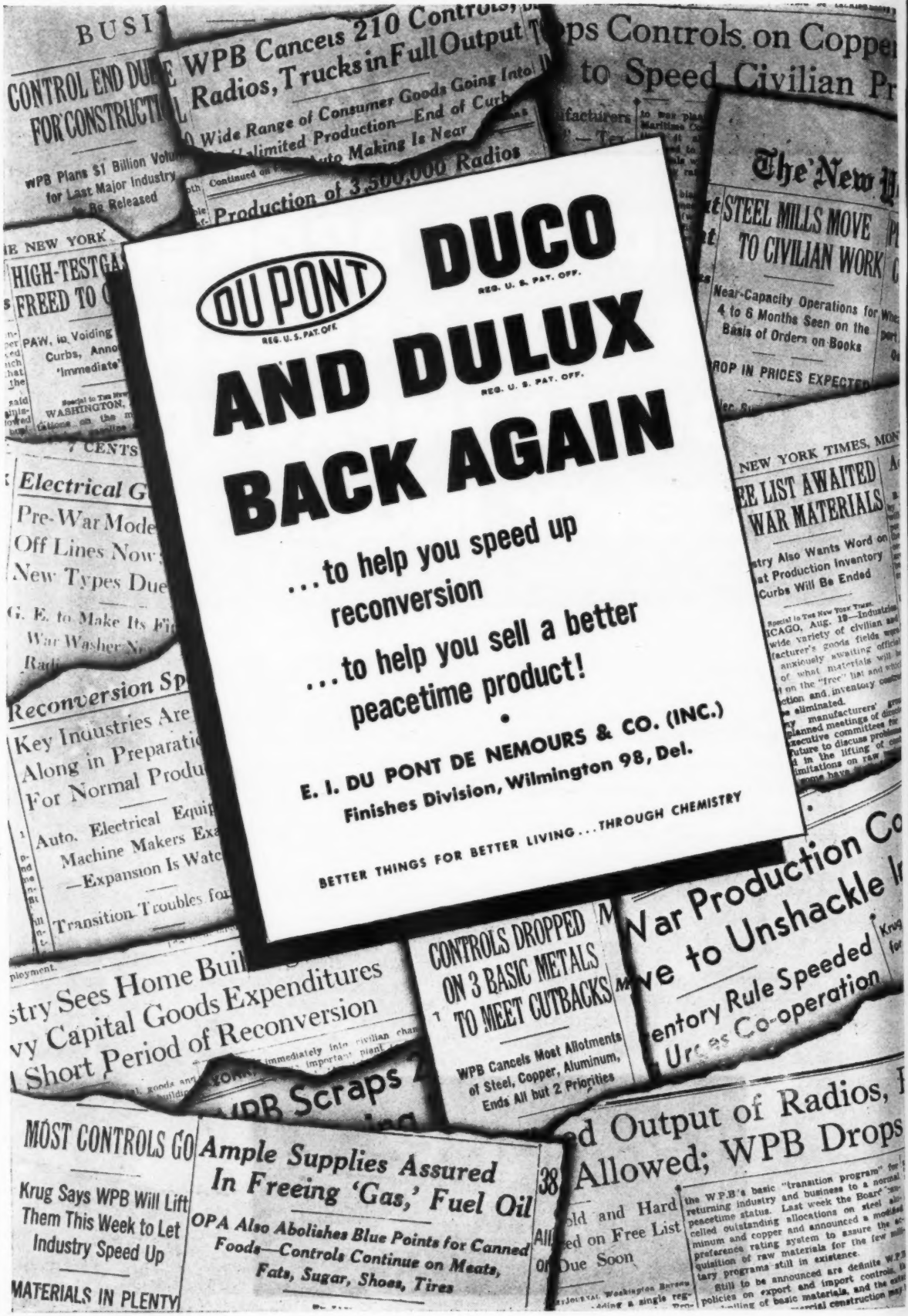
Engineering Goes to Work

PRECEDENTS BROKEN COSTS ARE REDUCED PRODUCTS IMPROVED EFFICIENCY INCREASED

● This isn't Fable but Fact... good, cold, hard fact... proven first by Morrison Creative Engineering, then by lower costs and satisfactory operating results in the field.

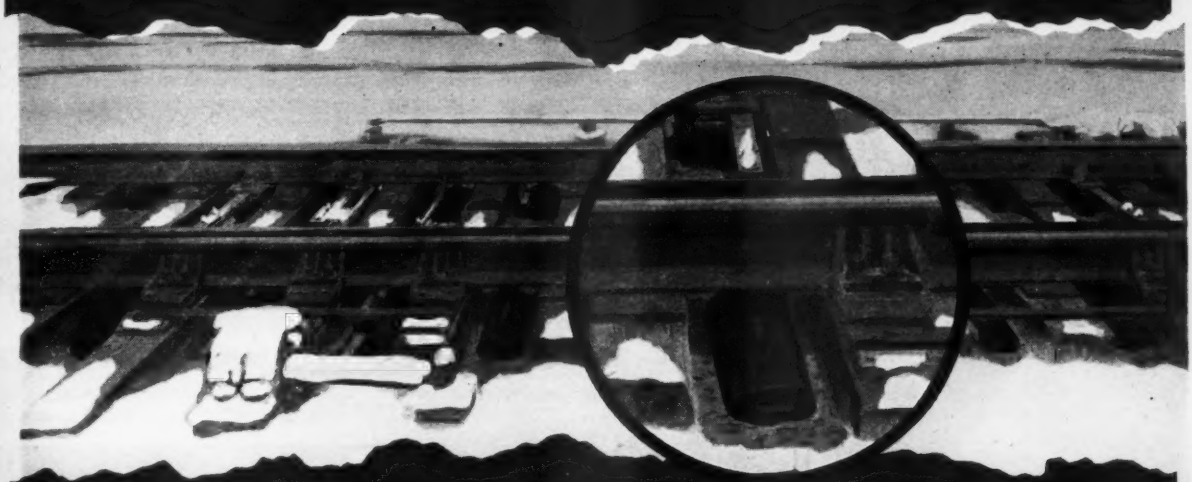
Here's the story: One day, not so very long ago, Morrison received a request from one of the nation's largest trunk lines, for a bid on a conventional water track pan installation. So far, all was routine, things like this happen every day in our offices. Shortly, and also routine, the papers were routed to our Engineering Department. **Then things happened.**

"Here is a natural for welded design!" (we're quoting our engineers). "Why shouldn't we redesign it for welding... it will cost less and do a better job. We can offer our design as an alternate for their consideration." Well, we did just that, and our alternate specifications and plans were accepted as an improved method and under actual service has proven to be an installation better than the old riveted type, plus costs reduced by at least 25%. That's just one example of how Morrison Creative Engineering works. There are other examples just as imaginative and just as practical. If you can use this type of engineering... if you believe that nothing was ever done but what might have been done better... then give us your problem and leave the rest to us to prove.


DU PONT
REG. U. S. PAT. OFF.
DUCO
REG. U. S. PAT. OFF.
AND DULUX
REG. U. S. PAT. OFF.
BACK AGAIN
...to help you speed up reconversion
...to help you sell a better peacetime product!
E. I. DU PONT DE NEMOURS & CO. (INC.)
Finishes Division, Wilmington 98, Del.
BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY
WPB Cancels 210 Controls; Radios, Trucks in Full Output
Wide Range of Consumer Goods Going Into Unlimited Production—End of Curbs Near
Production of 3,500,000 Radios
Controls on Copper to Speed Civilian Pr
The New Y
STEEL MILLS MOVE TO CIVILIAN WORK
Near-Capacity Operations for 4 to 6 Months Seen on the Basis of Orders on Books
DROP IN PRICES EXPECTED
NEW YORK TIMES, MON
EE LIST AWAITED WAR MATERIALS
Industry Also Wants Word on Post Production Inventory Curbs Will Be Ended
CONTROLS DROPPED ON 3 BASIC METALS TO MEET CUTBACKS
WPB Cancels Most Allotments of Steel, Copper, Aluminum, Ends All but 2 Priorities
War Production Co Move to Unshackle I
Inventory Rule Speeded Urges Co-operation
MOST CONTROLS GO
Krug Says WPB Will Lift Them This Week to Let Industry Speed Up
MATERIALS IN PLENTY
Ample Supplies Assured In Freeing 'Gas,' Fuel Oil
OPA Also Abolishes Blue Points for Canned Foods—Controls Continue on Meats, Fats, Sugar, Shoes, Tires
d Output of Radios, Allowed; WPB Drops
Sold and Hard ed on Free List Due Soon
Transition Troubles for
Reconversion Sp
Key Industries Are Along in Preparati For Normal Produ
Pre-War Mode Off Lines Now New Types Due
Electrical G
HIGH-TEST GA FREED TO
PAW, in Voiding Curbs, Anno 'Immediate'
WASHINGTON,
7 CENTS
IE NEW YORK

WEATHERPROOF YOUR SWITCHES THIS WINTER WITH DEPENDABLE

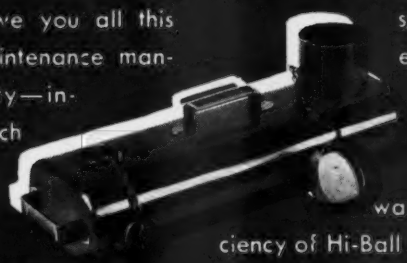
HI-BALL SWITCH HEATERS



THEY'LL EARN MANY TIMES THEIR COST

The best you can ask of a switch heater is dependability—that it will keep on doing its job day in and day out—24 hours a day—with the minimum of attention and upkeep.

Hi-Ball Switch Heaters give you all this and more. They reduce maintenance man-hours. They promote safety—increase production hours. Each unit operates 30 to 40 hours on less than 1½ gallons of kerosene, making it possible to service them when convenient.



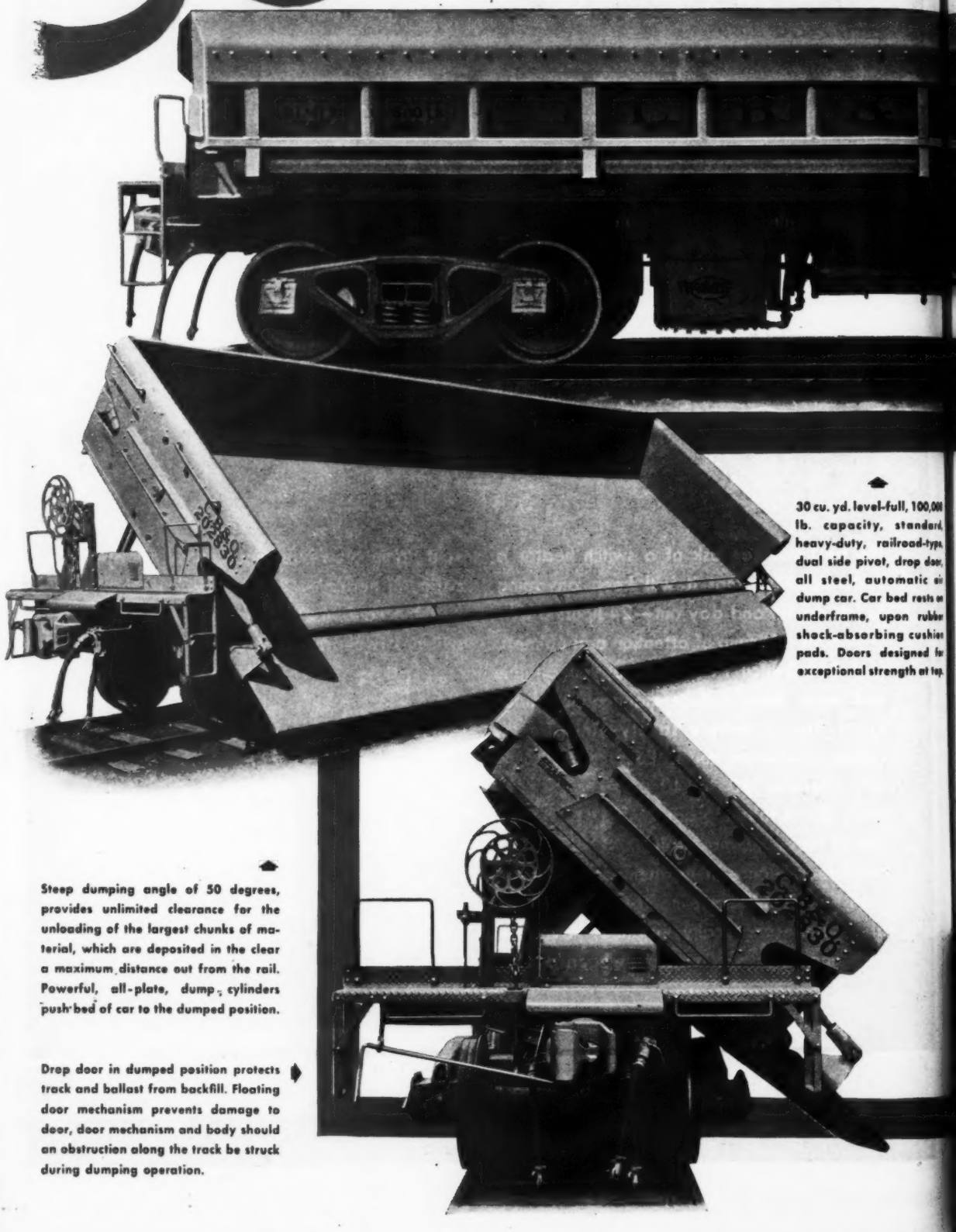
Hi-Ball Heaters come in self-contained units, are more economically installed, have low maintenance costs, eliminate fire hazard, prevent flame blow-outs, and control the application of heat.

If the cold-weather performance of your switches is a problem, you will find the answer in Hi-Ball Switch Heaters. It will pay you to find out about them now—before you need them. The most satisfactory way to demonstrate the efficiency of Hi-Ball is to make a test installation—it costs little and will show you more than we could ever do in words. Send for complete information today or arrange for a test installation.

MISSISSIPPI SUPPLY COMPANY

89 ELMGROVE AVE., PROVIDENCE 6, R. I. RAILWAY EXCHANGE BLDG., CHICAGO 4, ILL.

50 for the

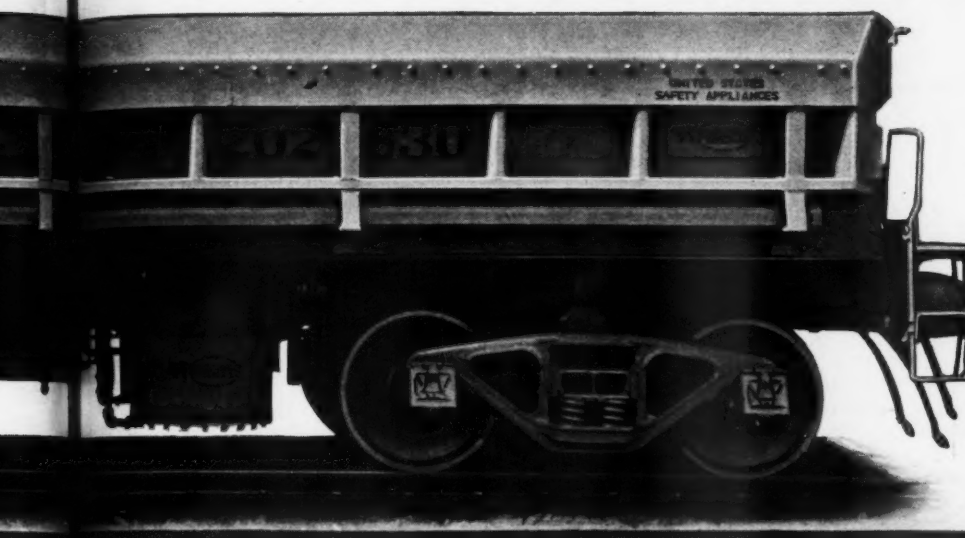


30 cu. yd. level-full, 100,000 lb. capacity, standard, heavy-duty, railroad-type, dual side pivot, drop door, all steel, automatic air dump car. Car bed rests on underframe, upon rubber shock-absorbing cushion pads. Doors designed for exceptional strength at top.

Steep dumping angle of 50 degrees, provides unlimited clearance for the unloading of the largest chunks of material, which are deposited in the clear a maximum distance out from the rail. Powerful, all-plate, dump cylinders push bed of car to the dumped position.

Drop door in dumped position protects track and ballast from backfill. Floating door mechanism prevents damage to door, door mechanism and body should an obstruction along the track be struck during dumping operation.

BURLINGTON



After careful investigation and inspection of all makes of dump cars the Chicago, Burlington & Quincy Railroad Co. purchased 50 of the cars illustrated on these pages.

"Western" dump cars, built in all sizes and for all types of work, comply with A. A. R. & I. C. C. regulations and are universally acceptable for interchange service under load. Individual cars, or the entire train may be dumped at one time, standing still or while moving slowly ahead. Low center of gravity, stability running and dumping, fast and easy dumping are features of all "Western" dump cars. Light weight, streamlined construction combine with rugged strength to result in efficient, economical operation. Railroads are finding it profitable to discontinue the use of antiquated, old style dump cars in favor of the modern type shown here. More than 100 railroads are using "Western" dump cars and the number is constantly increasing. Recent purchasers are shown in the following list:

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC R. R.
SPOKANE, PORTLAND AND SEATTLE RAILWAY SYSTEM
COLORADO & WYOMING RAILWAY COMPANY NORTHERN PACIFIC RAILWAY
MAINE CENTRAL RAILROAD NORFOLK & WESTERN RAILWAY ATLANTIC COAST LINE

AUSTIN-WESTERN COMPANY

AURORA, ILLINOIS • CABLE ADDRESS: AWCO, AURORA

202 of a Series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING CORPORATION
105 WEST ADAMS ST.
CHICAGO 3, ILL.

Subject: Service—Our Satisfaction

October 1, 1945

Dear Readers:

We hope that you find this issue of Maintenance and the November issue two of the most interesting and helpful issues of the year. In the present issue, continuing a long-standing practice, we bring you a report of the Roadmasters' Annual Meeting, held in Chicago on September 12, complete with a running story of the activities at that meeting, all five technical committee reports presented, and an abstract of the discussions which followed their presentation. In the November issue, repeating a service rendered since Railway Engineering and Maintenance was inaugurated in 1916, we will similarly report in detail the annual meeting of the American Railway Bridge and Building Association, including all of its eight technical committee reports.

We hope that these two issues will prove of real service to you and to the two associations concerned, especially in another year when conditions have made it necessary to restrict the meetings of both associations in scope and attendance. From the standpoint of the associations, we have the word of the presidents of both that our efforts are of value and are appreciated. On July 25, E. L. Banion, president of the Roadmasters, wrote:

"Our association is particularly appreciative of the co-operation being extended by your publication. The October issue of Maintenance will not only afford our members an opportunity to read our valuable and timely committee reports promptly, but, equally important, through your story of what will transpire at our one-day meeting, you will help hold our association together as a strong and vital force in maintaining the railroads of the country adequate to the needs of these critical times."

Subsequently, on September 12, J. L. Varker, president of the Bridge and Building Association, wrote in part as follows: "The long-standing practice of your publication to make its November issue a convention issue has been of inestimable value to our association, and continuing this practice this year will be especially helpful since conditions have again made it necessary that our meeting be restricted in character and in attendance. We of the association will co-operate with you in every way to see that your Bridge and Building number will be a success."

With the greatest appreciation for the work of these two associations, which are needed more today than ever before, it is with satisfaction that we can support their efforts through our pages. That our efforts in this regard are in the definite interest of every one of you—our readers—makes our job doubly satisfying.

Sincerely,

NDH:jb

Neal D. Howard

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

NEW one-spot diesel sanding unit

For better and faster sand-servicing of diesels, SNOWCO has designed and built this new, four outlet sanding unit.

Prepared dry sand, unloaded directly from the box car into the receiving hopper, gravitates into a sand drum and from there is blown into the top of the 60 ton storage tank. The four strategically located sanding spouts (two on either side of the track) permit multiple sanding of diesel road locomotives, thus cutting down sanding time. Because the rubber hose spouts are easily adjustable, close spotting is not required. Operated from the ground by a tag line, the shut-off valve works with a minimum of effort.

Write now for complete information and facts about this new SNOWCO sanding station.

SNOWCO—a name to remember for Servicing Facilities

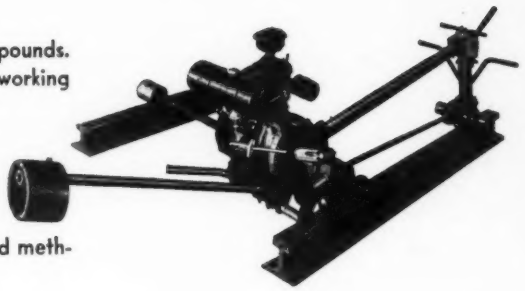
T. W. Snow Construction Co.
9 So. Clinton St. Chicago 6, Ill.

RACO POWER TRACK MACHINES

Efficient—Time—Labor Saving

One-Man Units for Tightening Bolts, Boring Ties and Drilling Rails

NUTTER



This mobile, one-man unit weighs but 385 pounds.

Speed of removal to or from rails, when working between trains, saves 10% of available time.

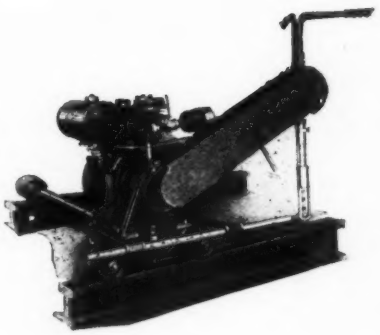
Fast from joint to joint, and stops easily at nut, without drift.

Use whenever joint or frog bolts are to be tightened, loosened or removed.

Annual savings of as much as $2000 over hand methods are common.

Extremely low cost of maintenance.

TIE BORER



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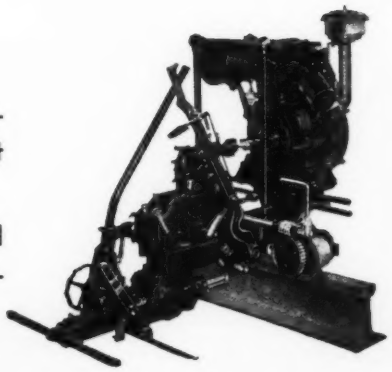

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Railway Engineering and Maintenance

Leadership—

Of a High Order Will Be Required in the Days Ahead

Faced with an era of intensive competition in transportation, calling for higher train speeds, faster over-all schedules, and improved service to the public generally, most engineering and maintenance officers know what will be required by the fixed properties of the railways—their tracks, bridges, buildings and water service facilities—to make this improved service possible. But will they show the initiative, the aggressiveness, the leadership and the salesmanship necessary to make possible the improvements that they know will be essential to the physical and economic well-being of these properties, and of the railroads as a whole?

Except in periods of relative prosperity, and in the case of a few roads where the management is "fixed-property" conscious, experience over the years has shown that the engineering and maintenance forces have, literally, had to "fight" for nearly everything they have gotten beyond that dictated by safety and immediate necessity or expediency. That many of them have been fairly successful in this fight is evidenced by the outstanding way in which the fixed properties as a whole met the heavy demands of war transportation, but with the new era of high-tempo railroading that is dawning, are they willing to continue to contend aggressively for those things which they know will be essential to the success of the railroads in that era.

Most engineering and maintenance officers agree that higher standards of track construction and maintenance will be required by the higher speeds and greater comfort that will be demanded in passenger service, but are they prepared to take the initiative aggressively for the larger programs of track stabilization, for the larger programs of roadbed strengthening and right-of-way grading, and for the improved standards of rail, ties and ballast that will be required by this service? Are they prepared to fight, if necessary, for the power tools, the work equipment, and their other needs, without which they cannot hope to carry out their work with the greatest efficiency and economy? Are they prepared to fight, if need be, for what they know to be the requirements for adequate passenger stations, for adequate freight houses, for adequate shops, enginehouses and other service buildings, especially as to design, materials and facilities?

In the track structure, railway engineering and maintenance officers have a special responsibility. More so than in the case of any other element of the fixed properties, management looks to them to insure the integrity, safety, smooth riding and economy of the track. Where present track is not adequate in any of these essential qualities, with increasing emphasis upon the factor of economy, will those responsible live up to that responsibility, or will they, as on one road recently, wait for the president of their road, of his own volition, to initiate higher track standards, and to introduce such commonly accepted devices as rail and flange lubricators?

In the years immediately ahead, which are certain to see the widespread adoption of technological improvements in materials, equipment and methods in every branch of industry and commerce, will engineering and maintenance officers assume the leadership to insure that the railroads will keep up with the parade? And going beyond the research and plan stage, will they show the salesmanship that will be necessary to see their plans through to fruition? As one maintenance man—exercised in his concern in this regard—put in recently, "Will they take the bull by the horns or will they catch it by the tail as it goes by?" The answer to this question will make a big difference in railroading in the next few years, if not for many years to come.

Heaving Track—

Can It Be Cured or Eliminated?

AS the railways prepare for the coming winter, provision will be made by northern roads to supply their section forces with track shims to restore the track surface where freezing and heaving may cause trouble. To some extent, such measures will, undoubtedly, always be necessary in extremely cold climates, but a number of things can be done to reduce or eliminate the causes of heaving.

Heaving track is caused by frost action on moisture in the subgrade or ballast. This happens because water increases in volume when it freezes. As the frost penetrates into the ballast and subgrade, no heaving will occur if very little or no water is present. Conversely, if the ballast is foul and wet, or if the subgrade is full of water pockets, badly heaved track will result with prolonged low temperatures. At road crossings, where the maintenance of adequate drainage may be particularly difficult, heaving of the track out of surface may present a particularly severe problem.

Obviously, a cure for track that shows a tendency to heave is the installation of clean ballast and adequate subdrainage, where necessary. In addition, in severe climates, bank widening will also help reduce heaving by minimizing the depth to which frost will penetrate embankments and get under the track.

Another measure adopted by a number of northern roads is the use of a medium ballast section, in which the ballast in the cribs is dressed full in the center of the track and sloped each way to a level 2 to 2½ in. below the tops of the ties at their ends. This ballast section, which provides clearance of about 1½ to 2 in. between the bottom of the rail and the top of the ballast, accomplishes two results; it provides better drainage when the ballast tends to become fouled, and it helps prevent an accumulation of sand and cinders from packing under the rail. Where such accumulations under the rails have not been prevented, and heaving conditions are particularly severe, the rails have been known to be lifted entirely off the ties or tie plates and to pull the spikes partially out of the ties.

An interesting example of methods used to reduce the amount of heaved track and shimming required is afforded by a large Canadian railway, which, according to its vice-president in charge of operation, has eliminated 80 per cent of the heaving on certain of its main lines by a program of bank widening and reballasting with new rock ballast, combined with installations of subdrainage in many embankments where water pockets existed. This road has also used salt successfully to reduce heaving in places where badly heaved track has been experienced in the past. Next year the road plans to continue its programs of bank widening and reballasting, and also to purchase equipment for grouting water pockets in locations that cannot be drained easily.

Shimming track is an expensive operation in that it requires not only the insertion of the shims, but also their removal in the spring as the frost goes out of the ground. In addition, shimming greatly reduces the life of crossties because of spike-killing, and, where severe, may call for slow orders on the track involved. For these reasons, measures to eliminate the causes of heaving track, including bank-widening, subdrainage or other means to eliminate water pockets, and the application of clean ballast, and measures to minimize such heaving as persists, such as the application of salt to the roadbed, pay large dividends. It should not be overlooked too, that measures to eliminate heaving in winter are also beneficial throughout the remainder of the year in producing better-riding track at less cost than otherwise.

Beating the Blitz—

Now the Story Can Be Told

READERS of the article in this issue by W. K. Wallace will experience mingled feelings as they learn how the engineering and maintenance departments of the British railroads outwitted the German Luftwaffe during the dark days of the Battle of Britain. Possibly uppermost in their minds will be a little prayer of thankfulness that the bombs were kept so far away from this country. Simultaneously there is almost certain to be a growing sense of admiration for those in England who planned and executed the measures that kept railway lines, terminals and stations in operating condition as the German air force strove with fanatical desperation to reduce them to a state of chaos.

In the days early in the war when American railroad men were reading carefully-censored reports in their daily papers of the terrific pounding to which the British were being subjected from the air, they must have had occasion to wonder frequently what was happening to the railroads and what measures they were taking to handle the situation. Here at last, prepared especially for this magazine, is a factual account of what transpired, including a considerable amount of information that has not heretofore been available.

One is immediately impressed by the extent and detailed nature of the advance planning behind the preparations that were made to meet the emergency. Apparently the English, while doing everything in their power to avoid war, were resolved to be prepared for the worst, for as early as 1938 the railroads were hard at work planning a strategy of action in the event war should develop. This realistic view also prevailed during the winter of 1939-40 when, while so many people throughout the world were making sarcastic remarks about a "phony war," the English railroads were using the period of inactivity to good advantage for building shelters and doing other work.

With their own man-power problem fresh in mind, maintenance men in this country will be greatly interested in that part of Mr. Wallace's article in which he discusses the problem of labor. The achievement of finding sufficient man-power to repair the damage caused by bombs, while at the same time carrying on essential maintenance work, appears as scarcely less than a miracle. In this respect, as in the United States, the English roads found themselves occupying the status of a "step-child" industry, with the government taking the view that the railroads would get along somehow, regardless of how many men were taken from them. That the British roads did carry on in spite of their difficulties is not a vindication of the government's policy, but rather, a tribute to the men whose skill and determination made the feat possible.

The article by Mr. Wallace is presented partly "for the record" and partly because of the interest with which it is

certain to be read by maintenance men in this country. It is possible that this interest will be purely academic, for it is the universal hope that a lasting period of peace lies before us. Of more than academic interest, however, are the foresight, the ability to plan thoroughly and in detail, and the calm fortitude which the maintenance men of Britain displayed during their country's darkest hour. Such attributes are equally as necessary in solving the problems of peace time as in dealing with the exigencies of a period of conflict.

Right-of-Way Grading—

A New Practice That May Be Worth-While

IN northern latitudes it is customary at this season of the year to make sure that all of the snow fences that will be needed are in good condition and that there are a sufficient number of panels of the portable variety to afford protection against drifting snow. While any repairs that may be needed to these fences should be made when they are taken down in the spring, experience has shown that it is wise to make a check of both the condition and the number of panels available before undertaking to erect them in the fall.

There are places on almost every railway in regions of heavy snowfall that have had portable snow fences erected annually ever since the line was first placed in operation, and no one has ever considered that any situation might arise under which they would no longer be needed, or that they could be eliminated without detriment to the operation of trains. Yet, they represent a considerable burden of expense, which is likely to increase rather than decrease, because of the scarcity and increased cost of the lumber from which they are constructed.

In the aggregate, also, much time and labor are involved in the distribution and erection of the panels in the fall and in taking them down and storing them after the danger of further snowfall has passed. In many localities a single line of snow fence is not sufficient to protect the track and a second or even a third line becomes a necessity, adding still further to the expense and the time that must be taken from other work to set and remove the additional lines. In other cases, the adjacent owner does not permit erection of the temporary fence on his property, making it necessary to set it too close to the track to afford full protection against drifting snow.

Maintenance officers have long known that snow trouble in cuts can be eliminated wholly, or at least greatly reduced, without the use of snow fences, by widening the cuts sufficiently and providing gentle side slopes, and that similar conditions can be made to prevail elsewhere, to some extent at least, by widening and smoothing the shoulders and slopes of embankments. However, heretofore the cost of such work has been high, too high, in fact, to warrant the general campaign of right-of-way grading called for, despite the fact that it carries with it important benefits beyond the reduction in snow trouble.

Of late, however, earth-moving equipment has become available which makes right-of-way grading—as the operation of widening cuts and embankments, of providing easy side slopes, of providing adequate and satisfactory drainage, and of smoothing the right of way generally, is called—practical, not only from a physical standpoint, but from that of cost as well. One of the former limitations sprung from the low capacity of the grading units, while another was that they were horse or mule drawn, and thus slow in movement and prescribed in range. The equipment available today overcomes both of these limitations, and being self-propelled, minimizes the importance of overhaul, one of the large elements of cost in former days.

Obviously, right-of-way grading is not a cure-all for all of the ills with which the track and roadway are afflicted. On the other hand, those roads that have tried it out have, with few exceptions, reported enough benefits to warrant a continuation of the grading operations on all important lines and, in some instances, on certain branch lines as well.

Fire Extinguishers—

Use Care in Placing to Avoid Fires

IN many cases insufficient consideration is given to the location of fire extinguishers, especially in busy freight houses. It has been proved by experience that the immediate availability of a fire extinguisher may mean the difference between an inconsequential blaze and a disastrous conflagration. For this reason, the location of fire extinguishers already installed should be checked from time to time to insure that they are where they should be to afford maximum availability and, therefore, maximum protection. After an extinguisher has been installed, changes in arrangement or in operation may make what was originally an excellent location, one that is difficult to reach at any time, and particularly difficult in an emergency.

In general, it is desirable that extinguishers be placed immediately adjacent to the area to be protected, and in such a position that they cannot be overlooked, even in the excitement that usually attends the discovery that a fire has started. They should be equally easy to reach, and obstructions that might interfere with their ready accessibility should be avoided. These requirements dictate that they be placed in corridors and passageways, but offsetting the desirability of these locations on the grounds of visibility and accessibility is the danger that the extinguishers themselves or their supports may be knocked down and damaged by passing trucks.

In addition to the extinguishers that are placed in or adjacent to the area to be protected, it is generally considered good practice to place one in the foreman's office and in each checker's booth. Wherever placed, however, every extinguisher location sould be marked in some distinctive way, such as painting the wall or the post upon which the extinguisher is hung with a color of high visibility for daylight observation, and by a light of similar color by night.

The shelf supporting an extinguisher should be low enough so that an arm can be slipped easily and quickly through the strap on the extinguisher before it is lifted from the shelf. If more than one extinguisher is needed to protect an area, they should be so distributed that each one will cover a prescribed area. But the cardinal rules should always be that they be placed where they will not be cut off by small fires, and that they be readily visible and easily accessible.

How the Railroads in England

By W. K. WALLACE

Chief Engineer, London, Midland & Scottish Railway, London, England

This article, written by the chief engineer of England's largest railway immediately after V-E Day, at the request of *Railway Engineering and Maintenance*, tells in detail for the first time the story of how the British railroads weathered the "blitz" and subsequent flying-bomb and rocket attacks. It describes the types of damage sustained by tracks, bridges and buildings, and tells of the organization, methods and equipment by means of which repairs were made.

WHEN it became clear that Germany was bent upon aggression, the engineers of Britain's railways gave consideration to the steps necessary to maintain communications during the war. Later, a Civil Engineering Consultative committee was formed of the chief engineers of the four Main-Line companies and the London Passenger Transport Board, and held its first meeting on Dec. 21, 1938.

At this meeting the plans already made by the various lines were reviewed and arrangements were made for speeding up the provision of the organization, equipment and material for dealing with the coming conflict. Bombing was anticipated, and lessons learned from the Spanish civil war were carefully studied, as it was realized that among the problems to be presented to the British railway maintenance engineer would be the restoration of bomb damage to tracks, bridges and buildings, the construction of protective structures in which essential staffs could remain on duty during air raids, and the provision of protection for other staff members who could take shelter in case of an "Alert".

Bridge Repairs

Arrangements were made by all of the railways for storing supplies of track materials at strategic points and plans were prepared for making emergency repairs to bridges, both over and under the railway. In Britain, the railways are seldom crossed at grade, which has resulted in a very large number of bridges of relatively small span that must be maintained. For example, on the London, Midland and Scottish, with 7,000 geographical miles of line, there are 10,384 bridges over and 15,375 bridges under the line. By far the larger part of these are of relatively short span, up to 70 ft., so that emergency repairs, in the first instance, were visualized as timber trestles supporting rolled-steel beam spans.

Later, the development of unit-fabricated structural steel trestling by the War Office led to the purchase and stocking of a considerable tonnage of this material for railway use, but unfortunately it was not available in quantity until the Battle of Britain was past and most of the bombing raids by piloted aircraft were over. It was, however, used during the flying-bomb and rocket attacks toward the end of the European war.

Although the great majority of bridges could be repaired by using rolled steel beams, there were some of larger span, and some situated over rapid or deep rivers, and so located as to be of extreme importance in the British railway network, that could not be repaired with these beams. To provide for the rapid repair or replacement of these bridges, four 120-ft. War Office spans, designed for end-launching, were obtained, and one was stored by each of the main-line companies. Close liaison was kept with the Army Bridging School in the Midlands so that if an emergency should arise requiring the use of these spans, military personnel skilled in their erection would be available. Fortunately, the enemy did not hit any of these important bridges, so that these emergency spans were not required and, in fact, have since been released for service in Europe.

Later experience during the "blitz" showed the advisability of having available some complete bridge spans suitable for carrying railway loading, and 26 bridge spans varying from 40 ft. to 80 ft. were acquired and stored at strategic locations by the railways. Only two of these were actually util-

The Less Damaged Parts of this Bombed Railroad Bridge Have Been Supported on Falsework—Other Steel Being Cut Up and Removed

Battled the Bomb "Blitz"

Filling a Bomb Crater in a Yard. Where Equipment Was Not Readily Available, It Was Often Found Faster to Use Large Amounts of Man-Power for Such Work

ized, but they have proved extremely valuable. They are plate-girder spans of the half-through type, and can be erected with bolted connections and temporary timber decks, but are designed to be riveted up later, encased in concrete, and left as permanent structures.

For the erection of this bridgework the railways had their existing equipment, which is usually of lighter capacity than that available in the United States, and some additional cranes, jacks, and other equipment. Some of the more interesting items of this equipment were eight Diesel cranes of 10-ton capacity, which were purchased by the L. M. S. These cranes are track-mounted, as the movement of crawler cranes from place to place is more difficult in Britain than in the United States, due to prevailing load restrictions, and at the time the units were ordered all crawler-track-making capacity was operated for the benefit of the army.

Trenches for Protection

At the outbreak of war severe pressure was put on the engineering departments of the railways because of the widespread demand for protection for the staff. The bricking-up of windows, the erection of blast walls at doorways, and the removal of glass from station roofs or protecting it against splintering by coating it with bitumen, reinforced with hessian, all made extensive demands, as the using departments all desired that the work be done immediately. Probably American engineers have had exactly the same experience when dealing with operating officers, and will visualize exactly what occurred.

The original conception of air raids was the arrival of hostile aircraft, the dropping of bombs, the departure of the bombers, and an "All Clear." It was thought this might occur at any hour of the day or night, so protection of staff had to be provided as near as possible to their places of work. This was done in many ways, including the utilization of existing subways and other structures which would be safe from blast effect, but most of the protection was provided by trenches lined with either timber or reinforced concrete pre-cast units, and, in the early days, a liberal provision of sand bags.

From the engineer's point of view, the chief advantage of using sand bags was that it encouraged self-help on the part of employees. Where labor to construct trenches could not be found, it was an easy matter to furnish sandbags to the local staffs, with instructions as to how they were to be used. Members of these staffs, realizing their importance to the nation's war effort, could be trusted to fill them to afford themselves protection. This protection was not always on the most scientific basis, it is true, but at any rate it provided a feeling of confidence.

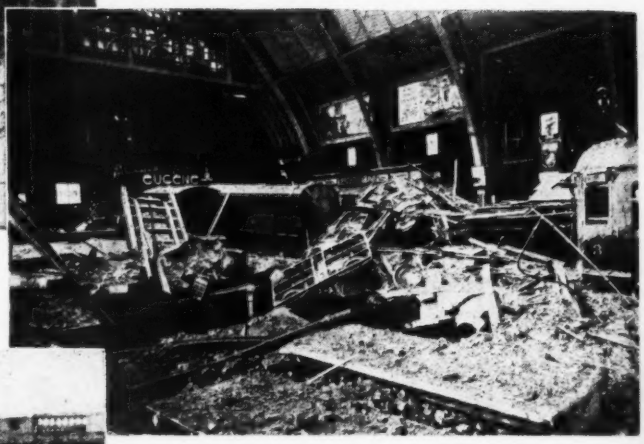
The first few sporadic raids led to stoppage of work and taking shelter, and if this had continued it would have impeded the war effort seriously. Fortunately, familiarity with raids bred contempt and more and more of the staff refused to go to shelter, although a number still ceased work. More elaborate warning systems, which differentiated between "Aircraft Approaching" and "Imminent Danger," assisted in maintaining continuity of employment, and, during the severe night-long raids which some of our cities experienced, it was very interesting and heartening to hear in the quiet pauses railway shunting, or other normal operations, going on as usual.

Shelter Construction

In addition to providing splinter- and blast-proof protection for the staff at large, there were certain key men—the equivalent of American train dispatchers—who had to be given protection which it was hoped would be absolute. Accordingly, elaborate concrete shelters were constructed to protect this stff. On the writer's railway there were two cate-

Pictures Afford a of the Damage

Above—The Construction Used at this Location to Replace a Damaged Bridge Consists of Rolled Steel Beams on Timber Bents



Above—A Large Bomb Penetrated to the Basement of this Station and Then Pierced the Arch of a Railroad Tunnel Underneath

Above—The Bomb that Damaged This Masonry Arch Uncovered an Interesting Type of Spandrel Construction. Right—The Damage Sustained by this Girder Bridge Was Caused by a Bomb that Detonated Behind the Abutment

gories of such shelters. One of these had a heavily reinforced concrete roof four feet thick, a layer of earth or sand four feet thick, and an inner concrete shell two feet thick. The side walls were similarly in three layers, three feet, three feet, and one foot six inches thick, respectively. The floor was likewise three feet thick. All of the concrete was heavily reinforced in both directions, with heavy shear protection. The second category of shelters had continuous walls and roof one foot three inches thick. The floor was nine inches thick.

Heavy steel gas-tight doors were provided, and each shelter had an emergency ventilating plant which could keep the inside atmosphere sweet and slightly above atmospheric pressure, so as to prevent the entry of poison gas, if such should be used. These shelters operated quite successfully during many raids, and to the great joy of the operating staff, although, possibly, to the professional regret of the designers, none received a direct hit, so that their ability to withstand such a hit is still a matter of opinion and argument.

The most severe test of the first-class shelters was when one of them experienced the full blast of a parachute land mine, which detonated 25 yds. away. This did not incommode the staff, except for slight damage to the internal doors from the blast, occasioned by the fact that the outside door was not properly closed, and none of the staff was hurt in any way.

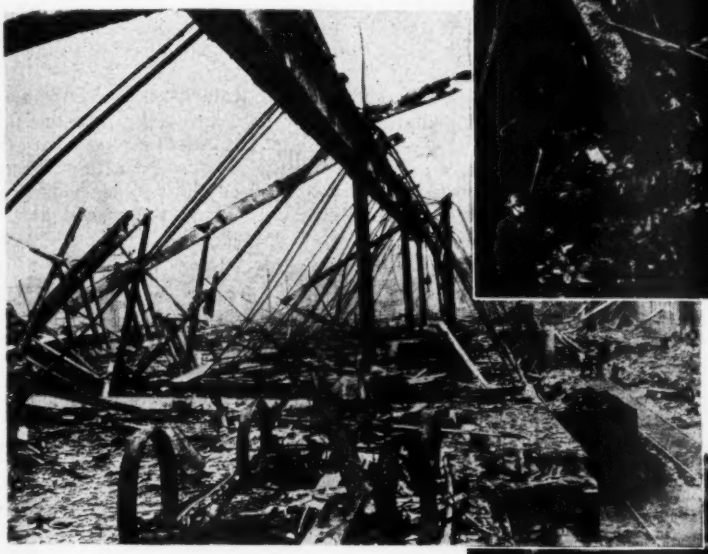
Bomb Damage Scattered

All of the foregoing construction work was well in hand immediately preceding and succeeding the outbreak of war, and the period known as the "phony war" was used to very good advantage by the railways in building shelters and in taking other precautionary measures.

Then came the Battle of Britain and the realization by the Luftwaffe that daylight raiding was impossible

Graphic Record Sustained

Above—A Bomb Hit on a Supporting Wall Between Two Platforms Caused this Damage at a Railroad Station. Note Troops Searching for Casualties



All That Was Left of a Freight Station After a Fire Started by Incendiary Bombs. The Roof Consisted of Composite Timber and Iron Trusses Carried on Wrought Iron Girders and Cast Iron Columns

Scattered About in this Bomb-Damaged Station Are a Number of Precast Concrete Platform Slabs, Some of Which Were Blown So High They Came to Rest on the Roof Purlins

without suffering crippling casualties. The railways then experienced the night-long bombing raids of the winter of 1940-1941, when in London a 12-hour alert, with bombing throughout the entire period, was an almost regular occurrence. During the same period, isolated attacks were made on provincial towns and cities and, owing to their smaller area, they suffered more intensive damage than was usual in London. For example, during the attack on Coventry on the night of November 14, 1940, the Coventry Avoiding Line, with a length of 3½ miles, had 73 incidents. Fortunately the bombs were mostly of the 50-kilo size, so that it was possible to reopen the line for traffic in six days.

It must also be borne in mind that the use of lights at night, to expedite repair work, was impossible. Furthermore, most of the staff wished to be with their families during blackout periods so as to be close at hand in case of another raid.

Owing to its geographical position, the bulk of the damage to the railways within London was suffered by the Southern, as its location required a shorter trip for the German aircraft than the other lines, but all the railways sustained an ample share of damage. This is seen in the following table, which records the number of incidents to railroad property by both ordinary bombs and V-1 and V-2 bombs.

Company	Number of Bomb Incidents
London, Midland & Scottish	3,108
London & North-Eastern	3,123
Great Western	1,467
Southern	4,453
London Passenger Transport Board	1,740

As the tracks of the London Passenger Transport Board are generally in subways, either deep or shallow, the damage suffered by them was quite different from that sustained by the main-line railways. The Board's organization specialized in repairs to brick and cast-iron-lined tunnels, although where its lines are in open country they sustained a considerable

amount of surface damage. The Board also had to protect against bombing in the Thames bed flooding its deep-level tube lines, and special water-tight doors were provided on each side of the river to shut off the tunnels, and thus localize any damage that might occur. As these doors had to be closed before damage occurred if they were to be effective, the line was closed to traffic and the doors were shut during an alert. This caused serious inconvenience to passenger traffic, but no other means of insuring safety could be devised.

Quick Reports on Damage

During the concentrated attack on London in 1940 and 1941, the engineering department had men on duty with the Control staff, who made investigations of damage as soon as possible after its occurrence. In the quieter periods during raids these men put on their steel helmets and went out and investigated reports of damage in their areas which had come in by telephone or dispatch rider. In the case of damage to the track, they would report the number of craters and their approximate dimensions, so that at starting time, or daybreak next morning, the district engineer would be able to arrange for equipment and material for rapid repair.

Fortunately the German policy of bombing seemed to be based on terrorizing the populace, with the hope that it would lead to panic and disrupt output. As a result, there was not the concentrated attack on the railways which was later the feature of Allied bombing in Germany, so that although after a "bad night" a chief engineer might find that he had a considerable number of holes in his track and two or three bridges down, the damage was usually so scattered that some of the lines in the multiple-track approaches to London were available, and the distribution of the damage rendered it easier to get repair gangs working simultaneously at several points.

Nevertheless, conditions were bad at times. The writer's line has three London terminals—Euston, which is approached by six lines, and St. Pancras and Broad Street, each of which is approached by four. One morning there was only one approach line to each of these terminals, the others being entirely blocked. This condition, however, did not prevail for more than a few hours.

Bomb hits in the track usually destroyed a pair of opposite rails, or two rails on each side, and the standard procedure adopted was to cast back into the crater the material that had been blown out by the bomb, filling out with carloads of cinders brought to the site, if possible, from both sides of the break in the line. The distribution of the bombing rendered it inadvisable to attempt to use mechanical earth-moving equipment, such as bulldozers, for filling craters, as too much time would have been required in traveling from crater to crater and in loading the equipment on trucks or cars to be transported from site to site. It was, therefore, better to decide on what route could be opened first, and then fill the craters by hand, following this up by track laying and opening the line for traffic under "Caution."

More delay was caused when a bridge, particularly an underbridge, was hit. A bomb explosion behind an abutment, throwing the abutment forward and collapsing the bridge superstructure on to the debris and roadway below, was the more common form of damage.

Rail approaches to London are characterized by long retaining walls, usually of brickwork or mass concrete with a brick face. In numerous cases these were damaged and thrown onto the track. South of the Thames the railways approach London on long viaducts, usually of arched construction in brickwork, interspersed with girder bridges over the streets. When a small bomb made a direct hit on an arched viaduct it punched a hole in the arch and detonated inside the span, but did not cripple more than the arch penetrated. A larger bomb, such as a 250 kilo, and a size commonly used, might blow out an intermediate pier and collapse two or more arches.

The method of repair in such cases was either to build a section of trestle with a rolled-steel beam deck, or to construct retaining walls at the broken ends of the viaduct and fill the space between solid. Girder bridges dropped into streets by failure of an abutment were usually replaced by a trestle, with emergency spans across the roadway, the damaged abutment and, possibly, also, the crater behind.

Building Damage

The bulk of the damage to buildings was probably caused by fire, due to either high explosives or incendiaries. The railways owned a large number of warehouses and store buildings constructed during the last century, which were not of modern fire-resistant construction, and when, as was frequently the case, they stored inflammable goods, they were a total constructive loss when set well alight. If the walls were not breached by bombing, the expansion of the unprotected wrought iron girder-work or steelwork of the floors frequently pushed out the walls.

Although the losses so caused were serious financially, they did not, as a rule, tie up railway traffic to any considerable extent, as the adjacent tracks could be cleared as soon as the debris had cooled down, and any steelwork cut up by oxy-acetylene flame and cleared away by power cranes. The accommodations lost by these fires were in many cases made good by the provision of new sheds designed to avoid the use of materials in short supply. On the L. M. S. these were usually of steel frame with siding and roofing of either corru-

A Track Gang of Women in Scotland Opening Up the Cribs Between Ties Preparatory to Measured Shovel Packing

gated protected metal or corrugated asbestos-cement sheeting. The former of these withstood blast better than the latter, but the choice of material was usually made on the grounds of immediate availability.

New Trackage Required

As in the United States, the war brought a large increase in traffic to the British railways, due primarily and immediately to the national effort and the cutting off of coast-wise shipping by U-boat activity and sea mines, and later, by the rubber shortage due to the loss of Malaya, as well as the severe restrictions on the use of gasoline. The British railways had a further problem to contend with, probably in a more acute form than was experienced in the United States. This was the diversion of traffic from its accustomed routes. After Denmark and Norway were overrun, the eastern ports of England became too hazardous to use for imports and exports, a situation which applied also to the southern ports — London, Southampton, etc.—after the collapse of France.

The concentration of imports and exports at Britain's West Coast ports was further complicated by the convoy system, which led to traffic conditions of either "a feast or a famine." In consequence of this, a large mileage of additional tracks—main line, side tracks and loops — had to be provided to move traffic to and from the west coast and prevent congestion. This entailed four-tracking a number of double-track lines and providing lengthy running loops for freight trains, together with a number of marshaling and traffic yards, additional dock sidings, and yards adjacent to the ports for receiving and making up trains moving to and from the Midlands.

This work was carried out under severe staff shortages and was done under contract or by company forces as conditions permitted at the time. The importation and use of modern American excavating and earth-moving machinery cut down the labor demand, but the goods loops built were so widely distributed, limiting the amount of earthwork at any one point, that the use of a large amount of equipment was impractical and uneconomical.

Concrete Rail Supports

Superimposed upon the labor difficulty was the shortage of timber, particularly ties. This led to the use of reinforced concrete as a substitute, either as a complete tie or as an isolated block (pot) under each rail, with or without tie bars connecting the two blocks.

The concrete pots were used very extensively in the new marshaling and storage yards, gage being maintained by using a full-length crosstie for every third or fourth rail support, although on curved track ties were used as frequently as every other support. In all, 257¾ miles of running tracks and 734½ miles of sidings were laid by Britain's railways.

Labor Conditions

American engineers well know that the British railways are usually maintained by "length gangs," groups of four to eight men, maintaining all running tracks and sidings between given points. Since this staff is permanent the year round, which is possible through the more uniform climate of Britain, the railways had a considerable number of men above military age in their length gangs, and thus did not lose to the army and industry the large proportion of their men that would have occurred if the average age had been lower.

This did not apply to the extra gangs normally employed to carry out relaying, and these suffered from loss of staff. As in America, the railways were subject to being regarded by the Government as a natural phenomenon, which could be expected to function regardless of trouble, and it was some time before adequate protection for railway staff was secured. Loss of staff in bridge and building crews was also severe as, under the war emergency construction program, contractors were able to offer higher wage rates than those paid by the railways.

The employment of women in lieu of men has made up some of the shortages in staff, and although track maintenance is not one of the best fields for female labor, women have been trained to pack ties and to handle materials at creosoting depots, and have also been used to a large extent in painting both bridges and buildings. Decorative painting has been entirely eliminated, the only painting authorized being to prevent physical deterioration. The manufacture of concrete sleeper pots has also been carried out by female labor.

On the writer's line, the average number of women employed during the war years was 1,004, of which 237 were employed in the technical and clerical staff, 277 in track work, 422 in bridge and building work, and 68 in miscellaneous work. The total includes 5 draftsmen, 3 architects, 91 trackmen, 1 over-head crane driver, 36 manufacturing concrete units, and 7 metal machinists employed in the manufacture of switches and frogs.

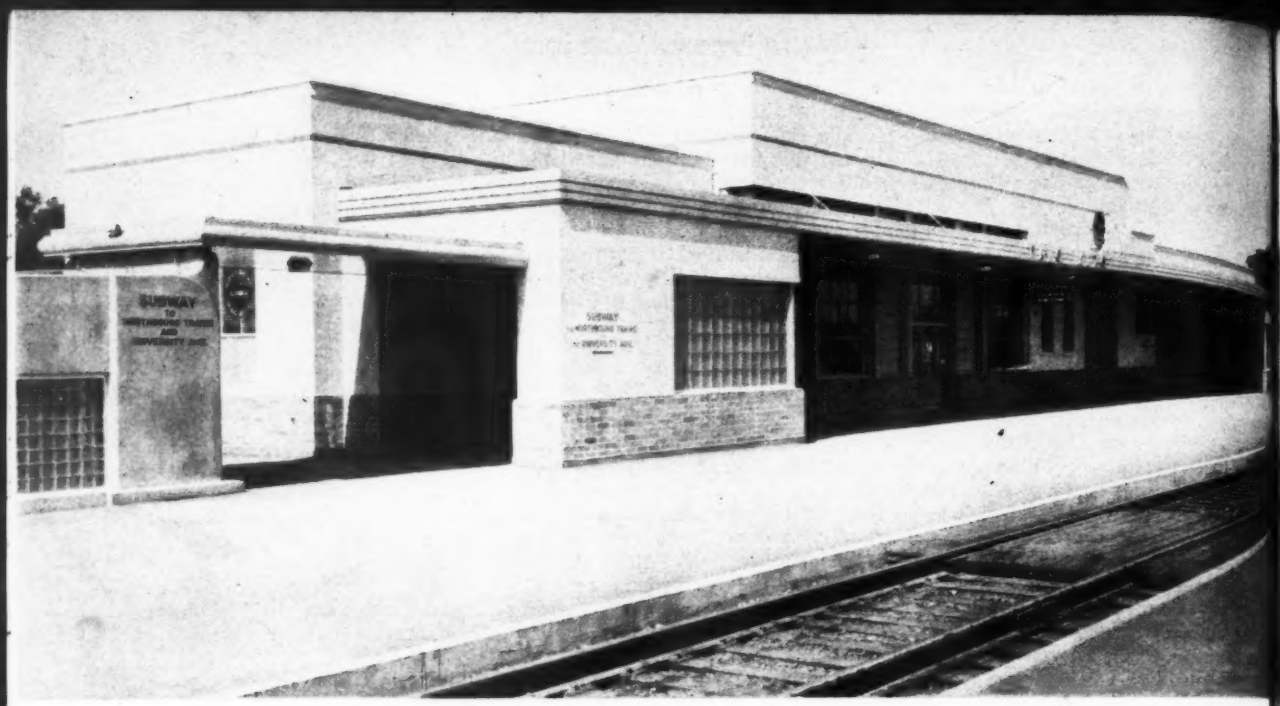
The outbreak of war found the tracks of the British railways in better condition than ever before; the refinements and improvements of the preceding years stood the country in good stead, and up to the present time there has been no need to apply blanket speed restrictions, as was the case in the first World War. On the writer's line, measured shovel packing of ties has continued and has proved a labor saver. At the onset of the war, ultra high-speed trains were withdrawn and timetables were recast with a maximum booked speed of 60 m.p.h., but with permission to run up to 75 m.p.h. to make up time. These changes were necessary to increase the traffic-carrying capacity of the lines, but the reduction of speeds had the added effect of reducing track maintenance, particularly on curves.

Rail From United States

The supply of track materials has been drastically reduced. British rail mills have been unable to supply even the reduced tonnages granted to the railways, so nearly 200,000 tons of British section Bullhead rails have been imported from the United States. These are of steel to the specifications of the American Railway Engineering Association, and are 39 ft. long, whereas the British standard is 60 ft. A considerable number of these rails have been flash butt-welded into lengths of 78 ft. and 117 ft., but the great majority of them have been used as received.

While the track has stood up to the war-time traffic very successfully, it cannot be denied that a considerable amount of deferred maintenance has accumulated, which will require some time to make good. Railway engineers anticipate considerable difficulty when demands will be made for pre-war speeds before the track is in pre-war condition. Reballasting and the cleaning of ballast have, of necessity, fallen into arrears.

To sum up, it seems fair to say that Britain's railways have come through the ordeal with credit to themselves and to the staff employed. The arrangements made for dealing with emergency repairs have, on the whole, worked well, although the incidence of damage was different from that anticipated. It was found that unnecessarily large provision had been made for track renewals due to bombing, and all of the lines had adequate bridge repair material available at all times. Since September, 1939, the British railways have passed triumphantly through a very hard school.



Stations of Modern Design Are Considered a Necessary Concomitant of High-Speed Streamlined Trains

What Will Be Done About Buildings?

For the last 15 years, through depression and war, buildings have been the most neglected facilities on the railways, until deferred maintenance has now reached the astonishing sum of $600,000,000, while the deficit in capital expenditures for buildings is almost as great. This article describes the results of a study made to determine the amount of building maintenance and construction that is likely to be undertaken in the years immediately ahead, now that the war is over, and the character of the work that is to be done.

IN CONNECTION with the study made of the probable future demands upon track, of the necessity for making up deferred maintenance, and of the effects of higher speeds on maintenance practices in general, the results of which were presented in the September issue, a similar study was made of future railway building requirements, of the present volume of deferred maintenance, and of the trend toward modernization which was so much in evidence when it became necessary to suspend this and other civilian activities and to concentrate all energies upon doing those things that were necessary to the winning of the war.

Although maintenance officers are familiar with deferred maintenance as a whole, as it affects their own roads, yet, in view of the primary necessity for overcoming the existing deficiencies in track maintenance which have accrued as the result of a prolonged record volume of traffic, restrictions on materials and shortages of labor, few of them appreciate that deferred maintenance on buildings is relatively greater than on other types of structures, including the track. It is still more difficult for them to visualize the vast sums represented by deferred building maintenance, and by deficits in capital expenditures on all of the railways, which have accumulated over a period of 15 years.

Drops More Than Half

In no year since 1930 have the expenditures for building maintenance risen much above 50 per cent of what has always been considered a normal outlay for this class of work, and in most of these years they have been considerably under this figure, while in some years during this period capital expenditures have fallen to approximately 10 per cent of normal. Measured on this basis, deferred maintenance on buildings has accumulated until it has now reached the astonishing sum of $600,000,000.

Building Needs Changing Constantly

Superimposed on these deficiencies in maintenance, obsolescence is also taking a heavy toll of railway buildings. Under normal conditions, the average service life of railway buildings for the use for which they were built originally, is about 20 years. Obviously, this does not mean that the average railway building is constructed, used for 20 years, and is then retired and torn down. It does mean, however, that in normal times few buildings are allowed to remain in their original form for a longer period; that changing requirements

of traffic and methods of operation require that most of them be remodeled or enlarged, although many buildings are retired every year.

Railway buildings are constructed for specific and highly specialized services. They provide facilities for receiving, forwarding and delivering freight, for the comfort and accommodation of passengers, to provide offices, to provide facilities for maintaining and repairing locomotives and cars, for servicing locomotives, for housing and distributing stores, for warehousing various commodities, for transferring freight from rail to water and vice versa, for pumping water and delivering it to locomotives, for fueling locomotives, for housing and maintaining roadway power machines and tools, and for a wide variety of other purposes.

Railway traffic, operation and maintenance are not static but are changing constantly. It is this constant change in methods and practices that tends to make railway buildings obsolete long before they have attained their normal physical life, for a building that is entirely adequate to meet today's requirements may be as fully unsuited for those of tomorrow. In this connection it should be kept in mind also that at no time in railway history have so many or such radical changes occurred in traffic requirements and methods of operation as during the last 15-year period of subnormal building construction and maintenance.

Despite the extreme need for up-to-date facilities for carrying out the multitude of and widely-diverse activities that combine to make up railway operations as a whole, only a negligible amount of new construction or remodeling of existing buildings has been accomplished for 15 years. Recognition of these facts makes it obvious that there is at present a tremendous back-log of repairs, alterations and new construction that must be undertaken, not only to bring railway buildings up to date, but to keep pace with the rapidly changing requirements of today's transportation, as well as to meet the severe competition of other forms of transportation that is certain to arise.

What Are the Prospects?

What are the prospects that this work will be undertaken and what classes of buildings are likely to be given first consideration? Most maintenance officers expect the existing labor stringency to continue for some time, but they also expect that it will be possible to build the bridge and building forces up to normal more rapidly than other categories, especially the track forces. In the months immediately preceding the war, an excellent start was made on the modernization of stations, shops, enginehouses and water and fuel stations, although the amount of work that was done in most instances was only a negligible part of what was needed.

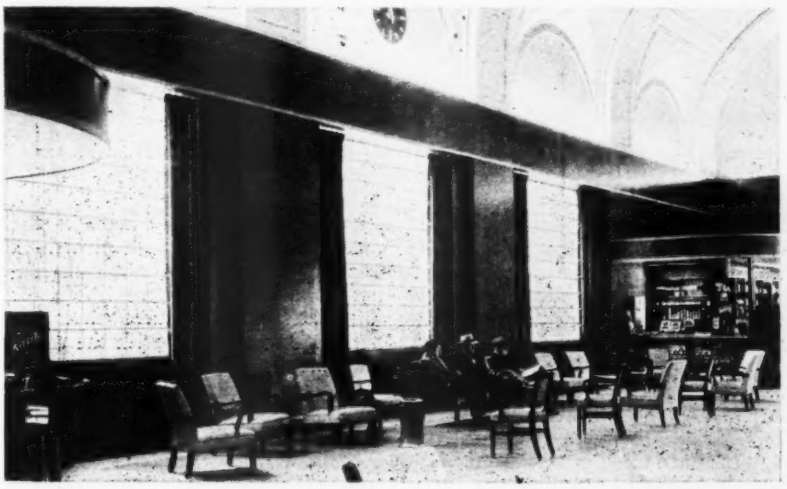
During the war years some improvements were made to shops, enginehouses and water and fuel facilities, to avoid delays to and interference with war traffic, and while this aggregated a considerable amount of work, they too, hampered by restrictions on materials and by shortages in labor, but little more than scratched the surface and left the underlying needs untouched. There is ample evidence that these activities will now be resumed almost at once, on a small scale at first, but that they will grow in volume as the labor situation returns to normal and building materials become more readily available.

Buildings Are Obsolete

One of the most spectacular developments in the railway field was the luxurious, high-speed streamliner, with every convenience necessary to provide the ultimate in rail travel. As might be expected, this development created new demands on passenger stations and marked the beginning of a trend toward the complete rebuilding of many stations and the remodeling and streamlining of others. Passengers and railway officers alike recognize the complete incongruity of compelling patrons of the streamliners to pass through or wait in outmoded and ill-kept stations with their standard benches, their lack of decoration, their inadequate and dismal lighting, their general dreary appearance and their antiquated and poorly serviced toilets. It is no less incongruous to unload passengers from the luxurious setting of the streamliner into a similar station when they reach their destination.

Realizing this undesirable contrast between their streamlined trains and many of their obsolete stations with their depressive atmosphere, and aware that competitive forms of transportation are providing, or are having provided for them at public expense, facilities of modern design and attractive appearance, not a few railways are now preparing to resume the replacement of a considerable number of their oldest stations and the modernization and remodeling of others.

Railway building officers are already awakening to the opportunities thus presented to scrap the old fixtures and furniture and to replace them with modern designs that are both more attractive and more serviceable. While they are not planning to discard materials that have always been considered essential to building work, they are planning to supplement them with new materials, such as glass blocks, new forms of flooring, new wall materials, plastics for a variety of purposes, stainless steel, aluminum, chromium, and rubber, asphaltic and asbestos products in their many colorful combinations, to provide decorative treatment and, at the same time, increase the utilitarian value of the facilities. They are also looking to the earliest opportunity to substitute modern sanitary equipment for the distasteful toilet facilities that are



By Taking Advantage of New Developments in Finishing Materials, Lighting and Decorative Treatment, Station Interiors Can Be Made Highly Attractive

so commonly found in these outmoded stations. They will also use fluorescent, indirect and other forms of lighting and lighting fixtures to provide a wide variety of decorative and functional combinations.

Freight Is Affected

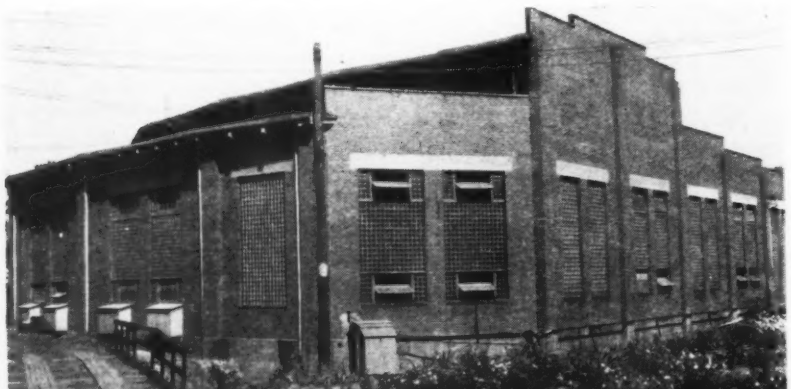
Peculiarly, the advent of the streamliner also created a demand for more expeditious handling and delivery of freight, and today, first-morning deliveries at stations 400 to 500 miles distant from the origin of shipments are so common as not to arouse comment, although only a few years ago second-morning deliveries over the same routes and distances were made in only a few exceptional cases. These demands for greatly expedited service have speeded up every operation in the handling of freight, from its receipt to its delivery. For this reason, the design and construction of freight houses and transfer platforms are assuming an importance not possessed heretofore.

One of the fundamental considerations in both freight houses and transfer platforms is that the floor be smooth to facilitate the trucking and transfer of the merchandise offered for shipment. To this end, large use is being made of concrete, asphalt, creosoted black gum plank, creosoted wood blocks and checkered steel plates as flooring materials. For modern freight-house operations it is necessary that doors be so designed as to be dependable in operation and that they provide clear passageways for trucks and trailers to avoid slowing down handling operations. Again, roofs must assure protection against the elements for the merchandise passing through freight houses, and building officers are selecting their roofing materials with more care than they once did. However, in addition to the fundamental requirement of protection, they are also selecting materials that have long life and low maintenance requirements.

In common with other classes of railway structures, expenditures for the upkeep of the 10,000 separate freight houses on the railways of the country have been restricted to less than half of the normal outlay, while expenditures for new freight houses have been restricted still more severely for a decade and a half. This, of itself, is ample assurance that with the return to normal, freight houses will be one of the important classes of buildings to receive attention, for they must be so laid out and equipped as to make possible expeditious transportation service.

Shops and Enginehouses

Probably no class of railway buildings has been more neglected or now stands in greater need of rehabilitation than shops and enginehouses. Normally, approximately one-fourth of the appropriations for building maintenance are applied to these buildings, and capital expenditures for their replacement and improvement are usually made in the same ratio. Limitations placed on building maintenance and construction have been still more drastic for this class of structures than for buildings as a whole, with the result that they are suffering more than others for adequate maintenance and for improvement. In addition to this situation, so many changes have been made in locomotives and cars and in their upkeep, that many of these shops and servicing facilities are now hopelessly out of date. It is true that a considerable number of shop buildings and engine houses were replaced or improved during the last year or more as an aid to the war effort, yet this was not done in sufficient volume to change the overall need for large programs of modernization.



Although Many Shop Buildings and Enginehouses Have Been Replaced or Improved in Recent Years There Is Still an Overall Need for Large Programs of Modernization

Engines Getting Bigger

During the last 15 years the average tractive power of all locomotives in service has increased more rapidly than in any equal period in railway history. During this period also, there has been a trend, slow in the beginning but continually gathering momentum, toward the use of Diesel-powered locomotives for switching service and for both passenger and freight road service. Whereas, with a few minor exceptions, all of the locomotives owned by the railways in 1930 were steam driven, at the end of June, 1945, the railways of the United States had in active service 3,202 Diesel locomotives with a total horsepower of 4,112,740. Of these, 265 were in freight service, 377 were in passenger service and 2,149 were switching locomotives, all on Class I roads. The remainder, 411, were owned by terminal and switching companies.

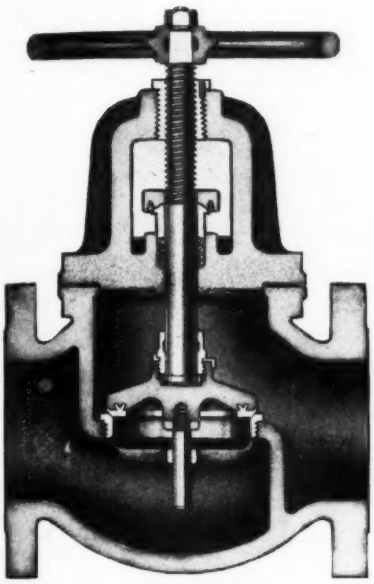
With this trend toward Diesel power, which is continuing on many roads, it is clear that many engine houses and shops and their equipment, designed and installed 20 to 25 years ago for conditions that differed greatly from those of today, are obsolete in every sense of the word, for they cannot be operated efficiently and economically under conditions that have changed so drastically. As a matter of fact, the railways are discovering that they must divorce the maintenance and repair of Diesel locomotives from steam locomotives, and are now beginning to build special shops for maintaining the newer type of power. Thus, almost in the same manner as progress in freight and passenger service has created a demand for improved passenger stations and more efficient freight facilities, it is exerting as profound an influence on shops and enginehouses, demanding the replacement or modernization of many structures.

True of Other Buildings

What has been said concerning the modernization of stations, freight houses, shops and enginehouses can be repeated for offices, water stations, fueling stations and other classes of buildings. It should be kept in mind also that the toilet

(Continued on page 1006)

Maintaining Water Service Facilities—



Flanged-End Globe Valve with Ground Bevel Seat and Rising Stem

Valves and Hydrants

Part I

By C. R. KNOWLES
Superintendent Water Service (Retired)
Illinois Central, Chicago

No. 14 of a Series

This is the first part of a two-part installment dealing with the maintenance of various types of valves and hydrants in use in railway water service. In this section the author describes the design of globe, gate and check valves, discusses the selection and installation of these valves as well as considerations involved in their inspection, operation and repair. Part II will deal primarily with hydrants and miscellaneous valves.

VALVES and hydrants are essential features of railway water supply systems. There are more than 546,000 valves in use in railway water stations and treating plants alone, while the total number of valves used for all railway purposes is in excess of 2,375,000, by far the great majority of which comes under the jurisdiction of the water department forces. There are also more than 250,000 hydrants of all kinds in railway water service.

The valves used in railway service comprise almost every kind of valve made. They include globe, gate and check valves, foot valves, float and altitude valves, air and relief valves, reducing valves, stop and plug cocks, and many other types and designs for special purposes. Those in most common use include globe, gate and check valves, which are as essential to a water supply system as the water mains themselves. It is this group that presents by far the greatest problem of maintenance.

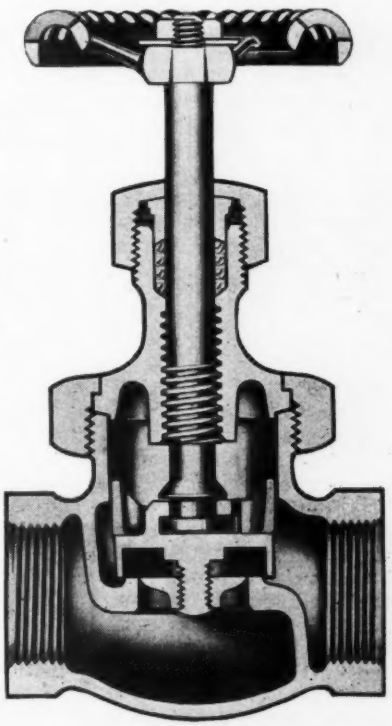
Globe Valves

A globe valve derives its name from the shape of the body, which is globular in form, with a removable bonnet at the top. This valve is normally a straightway valve, but is also made with the pipe connections at an angle of 90 deg. with each other, combining a valve and bend. This latter type is termed an angle valve. The seats of these valves are of two general types, (1) the plain or regrinding type, which has a beveled seat and disc, and (2) the removable-disc type, which is provided with a flat seat and composition disc. The valve disc in the latter type is usually of rubber or other composition, the composition used depending upon the pressure and service required. A few designs are made with both the seat and the disc removable.

The bonnets and stems are similar in all types of globe and angle valves and are provided with a packing gland through which the stem passes. In the smaller sizes, the bonnet is either screwed into the body of the valve or is held in place by a union or box nut. In the larger sizes it is flanged to the body. Globe and angle valves are usually made of brass in sizes up to 2½ or 3 in., while in the larger sizes the body, and sometimes the bonnet, is made of iron, with brass stem, seat, disc and packing nut. The valves are operated by a hand wheel on top of the stem. Valves of this type are made in both the straightway and angle patterns in sizes up to 14 in., but are used chiefly in the smaller sizes, especially for steam and air.

Gate Valves

Gate valves are similar in construction to globe valves insofar as the bonnet and stem are concerned. They differ materially, however, in the valve seating arrangement. In the gate valve, the disc or gate moves at right



Screw-End Globe Valve with Composition Disc

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angles to the line of pipe and across the seats which form the opening through the valve. The gate is provided with two faces, which fit tightly against the seats when the valve is closed, effecting a perfect closure if the valve is in good condition. As with a globe valve, the gate valve is opened or closed by means of a non-rising stem which screws into the gate, or by a rising stem which is threaded through an opening in the top of the bonnet, above the packing gland. The gate enters a recess in the top of the bonnet as it rises when the valve is opened, leaving a clear straightway opening through the valve. The stem is provided with a hand wheel for use chiefly on valves located above ground, and with a nut for operating with a valve key when used on underground lines.

Gate valves are of three general types—the wedge-gate type, the taper-seat type and the parallel-seat type. In the wedge-gate type, the gate is solid, and its two faces, as well as the two seat faces, are at a slight angle, so that, when closed, the wedge gate fits tightly between the seats. In the parallel-seat and taper-seat double-gate valves, the gates consist of two discs which are loosely connected to a nut on the stem, so that they move freely into the closed position, and are then forced apart and against the opposite seats by a wedging action of the nut.

Gate valves are used chiefly for water or other liquids as they offer less resistance to flow than globe valves. They are available in all sizes, the smaller valves being usually constructed of brass, while the larger ones are generally of cast iron, with brass stem, gates and seats.

Check Valves

Check valves follow the same general construction of globe and gate valves in the design of the body, but are automatic in action. They are designed to permit flow in one direction only, opening when pressure is applied to one side and closing when it is applied in the opposite direction. The seats are of various types, including the swing seat, bevel wing seat and ball seat. The swing seat is hinged and seats at a slight angle from the vertical, leaving a nearly straightway passage. The disc of the bevel-wing type has a vertical lift and is guided to the seat by wings on the bottom of the disc. Other types of bevel seats, particularly in the larger sizes, are provided with an additional guide in the form of a short stem on the top of the valve. In some cases a spring is provided on top of the disc to assure positive action and quick closing. A valve of this type is termed a spring-loaded check valve.

The ball-seat check valve consists of a metal or composition ball held in position by a cage and seating on a ground seat. Bevel and ball seats are used chiefly in the smaller valves, nearly all of the larger valves being fitted with swing checks. Check valves are made in horizontal, vertical and angle patterns.

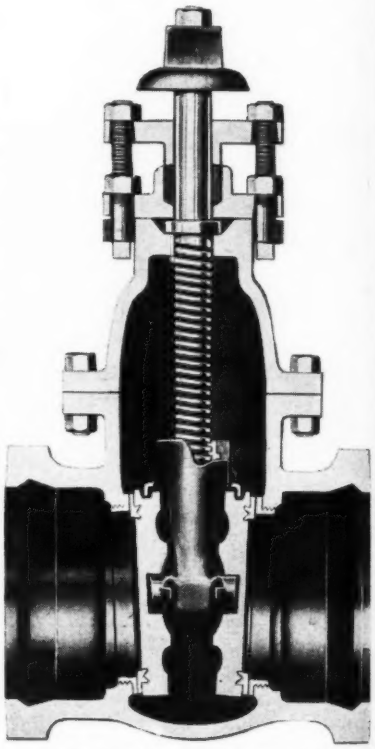
Selection of Valves

There are a number of features to be considered in the selection of valves for a particular service. The general rule is to use gate valves for water and globe valves for steam or air. A gate valve offers less restriction to the passage of water as it provides a straightway opening, which reduces the friction. This is of greater importance with water than with steam or air. A globe valve is usually preferable where it is to be opened and closed frequently, because there is less wear on the seats of valves of this type than on the seats of gate valves. The seats of a globe valve can also be repaired more easily by grinding or by applying new seats in the removable-seat type. Where the latter type of globe valve is used, suitable discs should be selected for the service required of them.

Soft rubber discs are used in valves handling cold water at low pressure, while harder rubber compositions are used for handling high pressure, and special composition discs for handling hot water and steam. Soft rubber discs will not stand up under high temperatures and the harder compositions are difficult to keep tight when used with cold water.

The pressure under which a valve is to be operated has an important bearing on the kind of valve to be used. It is hazardous to use on high-pressure lines, especially steam lines, a valve designed for low pressure. On the other hand, the use of more expensive high-pressure valves for low-pressure work is a wasteful practice. Globe valves are more desirable than gate valves where the valve is used for throttling, as gate valves will soon develop leaks in such service. Angle valves are desirable where they can be used to make a 90-deg. bend in a pipe line as they offer less restriction to flow than a valve and elbow and reduce the number of joints. A good general rule is to use swing checks in combination with gate valves and lift checks with globe or angle valves. Globe, gate and check valves used in chemical lines are usually made of iron because of the effect of caustic solutions on brass.

Consideration should be given to the position of the valve when it is installed. Whether the inlet pressure



A Hub-End, Tapered Seat Double Gate Valve with Non-Rising Stem

The Water Service Series

The 13 articles in this series, published previously, include the following:

(1) Introduction (April, 1944)
(2) (3) (4) Sources of Supply (May, June & July, 1944)
(5) The Maintenance of Pumps — Reciprocating Pumps (Aug., 1944)
(6) The Maintenance of Pumps — Centrifugal Pumps (Sept., 1944)
(7) The Maintenance of Deep Well Pumps (Oct., 1944
(8) Miscellaneous Pumps (Dec., 1944)
(9) (10) Power Units (Jan. & Feb., 1945)
(11) Power Transmissions and Controls for Pumps (April, 1945)
(12) Pipe Lines — Part I (June, 1945)
(13) Pipe Lines—Part II (Aug., 1945)

should be above or below the seat of a globe valve is a controversial subject. While sound reasons are advanced in favor of each method, the great majority of valves, perhaps 90 per cent, are installed with the inlet pressure below the seat.

Installing Valves

When a globe valve is installed in a boiler feed line, it is always advisable to have the pressure below the seat to avoid blocking the flow if the disc should drop off the stem. On the other hand, the argument is advanced that where a valve handles steam or hot water, the pressure should be on the top of the disc because of the possibility of the stem of a closed valve contracting and unseating the valve as it cools, causing it to leak. It is also claimed that valves are more efficient in operation when under constant temperatures. With the cold water valves, it would seem to make little difference whether the pressure is above or below the seat; however, unless there is some reason for applying the pressure from below the seat, as in a boiler-feed line, it would appear advisable to install steam or hot water valves with the pressure above the seat.

Most valves may be installed with the stem at any angle; however, it is desirable to avoid an inverted position. When the stem points downward, the bonnet forms a pocket for the collection of dirt, scale and other sediment which may damage the stem and interfere with the operation of the valve. The stems of gate valves should be upright wherever possible, especially those valves with double discs, to avoid the possibility of the discs becoming jammed when closing the valve. Check valves of the lift type should be installed so that the discs rise and fall in a vertical plane, swing freely, and will close by the force of gravity.

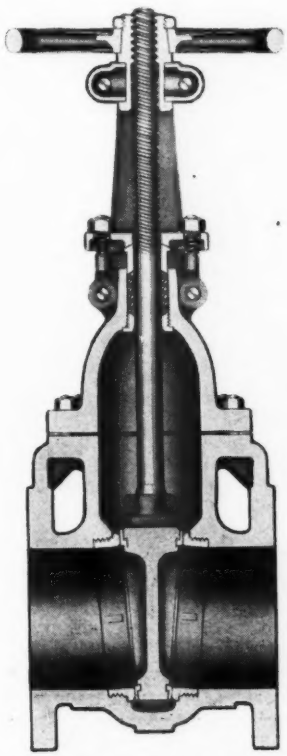
Inspection

All valves should be inspected and tested at regular intervals. This applies chiefly to underground or concealed valves, as other more easily accessible valves are so located that defects become readily apparent. Most underground valves are used at infrequent intervals and normally remain open or closed, except when it is necessary to operate them in the event of a break in the pipe line, or to permit repairs to some part of the system. If these valves are not operated for any considerable period of time, they often become clogged with sediment or scale, sometimes to the extent that they will not function.

All underground valves or other valves that are used but little should be inspected at intervals of at least six months, and more frequently when treated or highly turbid water is used. The valves should be opened and closed to loosen and dislodge any sediment or incrustation that may have formed. If the incrustation or other deposit cannot be removed by operating the valve, the bonnet should be removed and the valve and discs thoroughly cleaned.

Valve Pits

If the valve is located in a valve pit, the pit should be provided with adequate drainage. Where underground valves are not located in pits they should be provided with valve boxes to permit of their being operated from the surface by means of a valve key or socket wrench. These valve boxes



Flanged-End Rising-Stem Gate Valve with Solid Wedge-Type Seat

may be of the conventional design or may consist of a piece of pipe set over the valve stem.

Valve boxes should be well seated on the valve bonnet, and should have a well fitting cover to keep out stones or other debris that might interfere with the application of the valve key. Records should be kept of the locations of valves and also whether they open by turning to the right or left, as, in the absence of such information, it is sometimes difficult to determine whether the valve is open or closed. Underground valves on fire lines or other important services should be provided with post indicators that show at a glance whether the valve is open or closed.

All valves, regardless of their locations and use, should be inspected at least twice a year. The valve should be operated and oiled, and the packing renewed if necessary. Check should be made to determine whether the valve closes properly. Any repairs required should be made promptly. These inspections will prevent valve trouble before it starts, and will save time and expense not only in maintaining valves, but in the maintenance of the entire water system.

Operating Valves

There are few devices used on a railroad that are subjected to more abuse through improper handling than valves. Water service repairmen can save themselves much trouble by waging a vigorous campaign of instruction as to the many ways in which valves can be damaged by careless operation. Perhaps the principal abuse of valves is in using unnecessary force in closing them. Little pressure is required to close a valve if it is in good condition, yet it is common practice to close valves with sufficient force to damage the seat, and even to distort the body of small valves or to twist the stem in two. It seems to be the more or less general belief that the more force applied the better the closure. If the valve cannot be closed easily, it is an indication that there is something wrong with it, and when this happens repairs should be made promptly.

Size of Valve

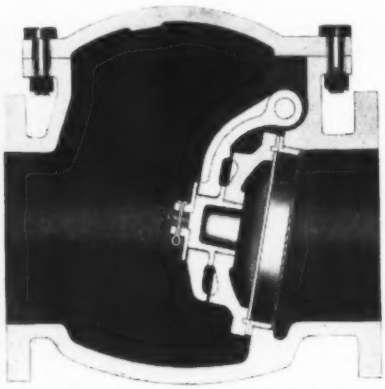
Due consideration should always be given to the size and kind of valve, as it may require a little more effort to open or close a large valve against pressure, especially a gate valve of the wedge type. The use of wrenches on the hand wheels of valves is an extremely bad practice, as under such practice it does not require any great effort to twist off the stem. On the other hand, failure to close a valve firmly usually permits leakage that causes a wire drawn seat and a leaking valve, with the ultimate need for a new seat or seats, or the replacement of the entire valve.

Closing a steam valve too tightly against the seat when cold invariably causes distortion and damage to the seat or stem through expansion when the valve becomes heated by the application of steam. Hand wheels of

valves should not be allowed to become loose or misplaced, as this invariably invites damage to the stem and valve through the use of pipe wrenches or other makeshift methods of turning the stem to open or close the valve.

Repairing Valves

Leaking valves should not be neglected, as permitting the valve to leak will damage the seating surfaces beyond repair. This is particularly true of gate valves. In many cases the leak may be due to dirt or scale lodging on the seat, and often repairs can be made by cleaning the valve



Example of a Flanged-End Horizontal Swing Check Valve

thoroughly. Great care should be taken in handling the smaller screw-end valves to avoid damaging the body. When placing a valve in a vise to remove the bonnet or for any repair work, always use soft lead or copper jaw covers. The valve should be placed in the vise with its ends to the vise jaws, and never with the sides of the valve body to the jaws. It is not only difficult to hold the valve firmly in the latter position, but it may damage the valve body.

When making up a joint at a bench the valve should not be placed in the vise because of the possibility of squeezing it out of shape. The pipe should be placed in the vise and the valve screwed on the pipe. In making up the valve the wrench should be placed on the pipe end of the valve. This avoids the possibility of squeezing or distorting the valve and permits of better leverage and a tighter joint.

In applying valves they should be closed, as there is less danger of damaging them when closed, and this practice also tends to keep out dirt. If pipe compound is used, care should be taken to see that no compound enters the valve. It should be applied to the pipe rather than to the valve threads. Larger valves are usually provided with flanged ends and there is less possibility of damaging them than threaded valves, but care must be followed in handling their stems and seats.

Most gate valves are so constructed that the seat rings are removable. These valves can usually be repaired by removing the seat rings and applying new ones, and, if necessary, by replacing the wedge discs or seats of parallel-seat valves. Stems are also renewable when badly worn or broken. If the seats are not badly worn, they can often be repaired by refacing them with emery cloth. Stems that are not too badly worn can also be repaired by smoothing them with emery cloth.

Leaking globe and angle valves with plain seats can usually be repaired by regrinding the seats without removing the valves from the line, provided the seats are not badly damaged. In regrinding valve seats the bonnet is taken off the valve and the stem removed. The disc is then removed from the stem by loosening the disc stem ring and then locking it tightly to the stem by inserting a coin between the end of the stem and the disc to take up the play between them, or, if holes are provided, as in the case of some valves, the seat disc may be locked by inserting a pin in the holes. The stem and bonnet are then replaced, screwing the bonnet or bonnet ring up two or three threads to provide a guide for the stem, which is then oscillated by means of the hand wheel until a smooth seat is obtained. A good emery base grinding compound should be used in this operation; never use dry emery powder as it is impossible to secure a perfect seat with dry or coarse emery. Also, use the compound sparingly, as to do otherwise is not only wasteful, but may remove too much metal. The valve seat and disc should then be cleaned before reassembling.

Valves fitted with composition discs can usually be repaired and made tight by renewing the discs, although it is sometimes necessary to smooth up their seats. This can be done by grinding or by using a valve reseating device. There are a number of such devices available, which can be secured from most water supply houses.

Selecting Disc

The selection of the correct disc for the type of service involved is of first importance. Where it is necessary to renew the discs at frequent intervals, it is advisable to keep a few extra disc holders on hand to save time in replacing them. Composition discs are available for steam, hot and cold water, air and oils. The same valve may be used for any service by merely applying suitable discs. This simplifies the problem of spare parts and valve stocks. Regardless of whether plain valves or valves with composition discs are used, repairs should be made as soon as the slightest leak appears, to avoid damage that might make it necessary to renew the entire valve.

What About Buildings?

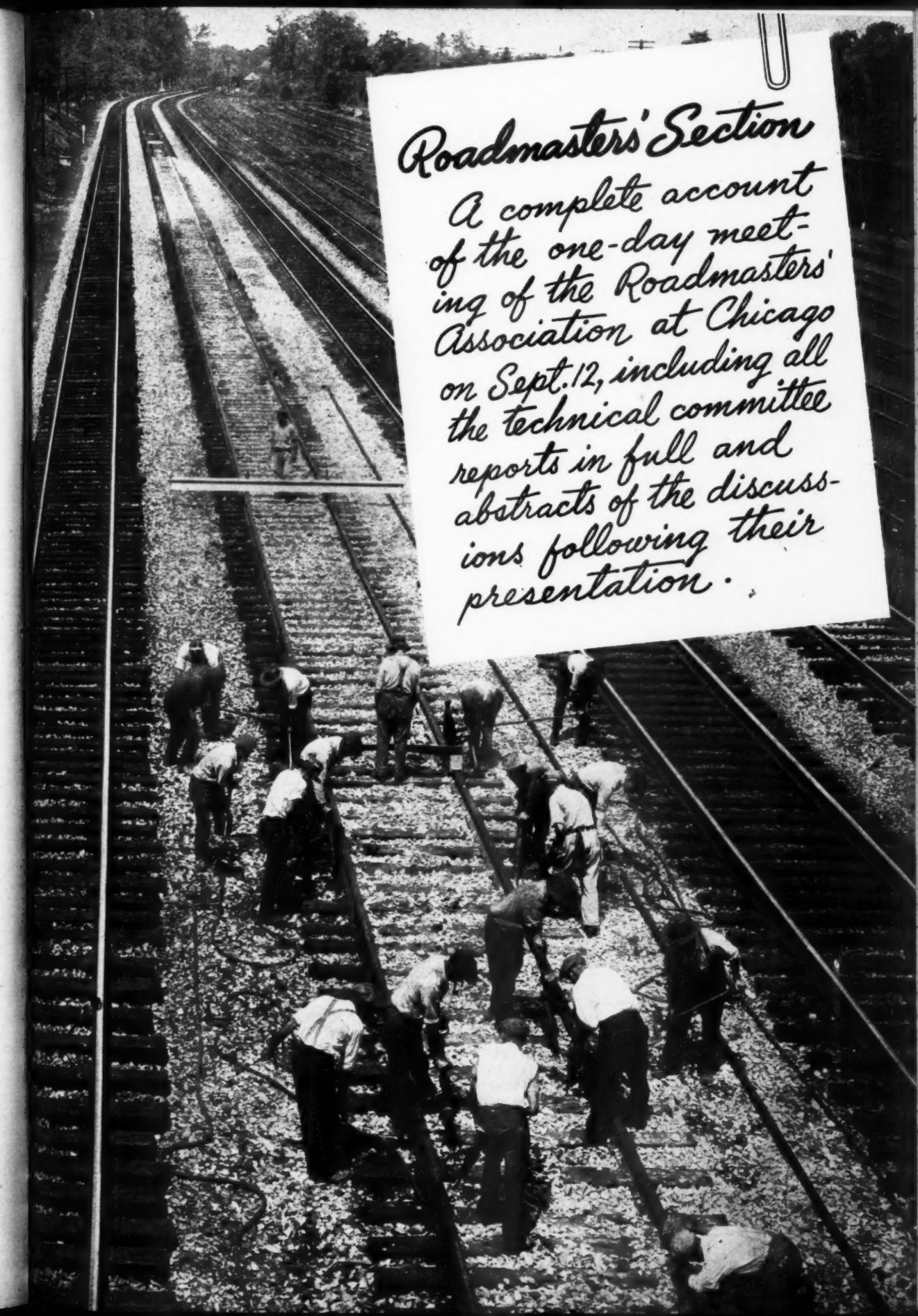
(Continued from page 1002)

facilities in some of these buildings are in no better shape, and many of them are far worse, than those in the average station. Furthermore, not a few structures, including particularly stations, offices, shops and enginehouses, require new facilities and equipment for heating, and some of them will be equipped with air conditioning.

All of the evidence available points to a marked resurrection of railway building activity after 15 long years of neglect and severely-restricted expenditures. This evidence has been weighed carefully by the engineering officers who participated in this study, and they are in general agreement that from now on buildings will be given the attention that their importance in the railway plant warrants. It is expected, therefore, that within a relatively short time the expenditures for building maintenance and construction will rise to the rate of $150,000,000 annually, which was considered normal prior to the depression.

New Materials

These officers are also in general agreement that large use will be made of the new building materials that have been developed in rcent years. However, as one officer put it, "We will have to be educated to their use, for we have done so little building work in recent years that we have had no opportunity to study them or to observe the results of their use." In general, the idea of air conditioning and the newer forms of and equipment for heating are equally unfamiliar to railway officers, and they must be educated to their use also. There is little doubt, however, that once educated to the many improvements in building materials, equipment and architecture, the railways will take full advantage of them in the interest of improving service to the public, of improving working conditions for their employees, and of effecting economies in routine maintenance costs.



Roadmasters' Section

A complete account of the one-day meeting of the Roadmasters' Association at Chicago on Sept. 12, including all the technical committee reports in full and abstracts of the discussions following their presentation.

Roadmasters Finish and Lay Plans

Amid confident expectations that it would be possible next year to resume the practice of holding three-day annual meetings, the Roadmasters' and Maintenance of Way Association held a restricted one-day session at Chicago on September 12. The day was a busy one, with those present listening to, and discussing, five technical committee reports, adding four new names to the association's roster of honorary members, electing officers for the ensuing year, and selecting six subjects for study by technical committees.

MEMBERS of the Roadmasters' and Maintenance of Way Association can rest assured that, notwithstanding the difficulties of recent years, their organization is "still in there pitching," and that it has emerged from the war-time period with every indication that it is going to be a potent and constructive influence in shaping maintenance of way practices in the difficult years ahead. To reach this conclusion one need only to have been present at the restricted one-day annual meeting held at the Stevens Hotel, Chicago, on September 12, where the prevailing spirit might be described as being a combination of determination and aggressiveness, mingled with a feeling of quiet confidence that the track man will prove equal to any problems that the future may have in store for him.

According to previously laid plans, the meeting was restricted both in the length and in the sense that it was attended only by members of the Executive committee, the chairmen of technical committees, and members in and about the Chicago area, the total registration being approximately 75 members and guests. Even though the war was over, and the O.D.T. had partially relaxed its war-time ban on conventions, no attempt was made to expand the scope or attendance at the meeting beyond the original plan, this being in recognition of the fact that the track maintenance forces, in general, have not as yet experienced any appreciable lessening of the heavy burdens that have kept them so closely on the job in recent years.

It was the third consecutive year that the annual affair of the association had been confined to a one-day meeting in place of the three-day convention that is normally held in peace time. In the 62 years since the association was founded, there have been only six years in which it has failed to hold full-scale annual meetings, the other three being in the period 1931-33, when the depression was a retarding influence. As in this earlier period of restricted activity, the recent interruption in the regular ten-

Roadmasters' Association

Officers 1944-45

E. L. Banion, president, assistant superintendent, A.T.&S.F., Needles, Cal.

H. E. Kirby, first vice-president, assistant engineer, C.&O., Richmond, Va.

E. J. Brown, second vice-president, engineer of track, Burlington Lines, Chicago.

Elise LaChance, secretary, Chicago.

E. E. Crowley, treasurer, roadmaster, D.&H., Albany, N.Y.

Directors

Cornell Halverson, division roadmaster, G.N., Willmar, Minn.

A. G. Reese, district engineer maintenance of way, C.B.&Q., Galesburg, Ill.

S. J. Hale, assistant superintendent, N.& W., Roanoke, Va.

R. L. Fox, roadmaster, Sou., Alexandria, Va.

Ray Marshall, district roadmaster, G.N., Superior, Wis.

A. L. Kleine, trainmaster, D.&R.G.W., Grand Alamosa, Colo.

F. J. Meyer, chief engineer, N.Y.O.&W., Middletown, N.Y.

A. B. Chaney, district engineer, M.P., Little Rock, Ark.

War-Time Business for the Future

H. E. Kirby
First Vice-President

E. J. Brown
Second Vice-President

E. E. Crowley
Treasurer

E. L. Banion
President

or of the association's affairs came at a time when its members, beset with a multitude of new and difficult problems, were particularly in need of the advantages inherent in full and complete discussion of these problems with their associates.

However, handicapped as it was by the limitations imposed on full-scale meetings, the association has been unfaltering in carrying on its most essential activity—investigating and reporting on current problems through the agency of technical committees—and thereby has continued to render a valuable service to its members and the railroads as a whole. Now, with the war emergency a thing of the past, there is hope and confidence that the association will in the future be able to return to three-day annual meetings, with its full strength and resources being devoted to solving the many perplexing problems that track men in general are certain to encounter in the coming years.

Although this year's meeting was restricted as to length and attendance, it was "unrestricted" in the amount of enthusiasm displayed by those present and in the quality and quantity of the work accomplished. Presided over by E. L. Banion, assistant superintendent, Atchison, Topeka & Santa Fe, Needles, Cal., the program for the day included the presentation and discussion of five comprehensive reports by technical committees, the election of four honorary members, the election of officers for the coming year, and the making of tentative plans for the work to be done in the year ahead, including the selection of six subjects for study by technical committees. Other items on the program included brief but inspiring addresses by the president and the president-elect.

The President Speaks

Because an election of officers was not held at the one-day meetings in 1943 and 1944, Mr. Banion appeared before the group for the third time in the capacity of president. In his opening address he reviewed the problems of the association, and of track men in general, during the last several years; spoke in words of appreciation of those persons and organizations who have made it possible for the association to carry on its work, even though on a restricted basis, during the year; thanked the chairmen and members of the technical committees for the excellent quality of the reports they had prepared; summarized the accomplishments of maintenance men during the war years in helping make it possible for the railroads to carry the record burden of traffic imposed on them; and then turned to a consideration of present and future problems of maintenance men, speaking in part as follows:

"Since V-J Day and the cessation of hostilities, the reconversion period facing us has added many burdens and has increased the difficulties facing maintenance of way officers; although the war-time problems have been eased, the problems of the months ahead will be even more severe. We must face rapidly mounting competition, demands for greater speed, greater travel comfort and many refinements in railway transportation, all of which will require rapid changes in our present standards of operation.

"Maintenance men accomplished miracles during the dark days of the past five years in handling heavy construction and maintenance programs, and now we must face an entirely new situation to keep pace with the rapidly changing picture. Of one thing we are certain, these men will not be found wanting in courage to meet the demands, whatever they may be."

Greetings From Supply Men

During an interlude early in the morning session, brief appearances were made before the group by H. C. Hickey, president, Track Supply Association, and Lewis Thomas, secretary of that association. After congratulating the Roadmasters' Association on the occasion of its first postwar meeting and for carrying on the work of preparing committee reports for distribution to its members during the war years, Mr. Hickey presented a gavel to Mr. Banion. Among other remarks, Mr. Thomas voiced the hope that it would be possible for the Track Supply Association to present an exhibit of maintenance of way equipment and materials to supplement the Roadmasters' convention in 1946, and then present-

ed a President's badge to Mr. Banion.

By far the largest item of business on the program was the presentation and discussion of the five technical committee reports. These reports, which are reproduced in full on succeeding pages, together with abstracts of the discussions that followed them, dealt with the following subjects: Field Repair and Maintenance of Work Equipment, Including Motor Cars; Prevention of Damage to Rail; Yard Maintenance Under Extraordinary Traffic; Stabilization of Roadbed; and Modern Methods of Right-of-Way Grading and Drainage. The reading of each of the reports was followed by a discussion period, all of which proved highly interesting.

Honorary Members

One of the outstanding events of the day was the election of the four honorary members, these including Herbert R. Clarke, chief engineer, Burlington Lines, a member of the association since 1920, a chairman or member of many of its committees, and president of the association in 1929; Gen. Carl R. Gray, Jr., director general of the first and second Military Railway Service, and, before the war, executive vice-president of the Chicago, St. Paul, Minneapolis & Omaha; Charles W. Baldridge, assistant engineer (retired), Atchison, Topeka & Santa Fe System, a member of the association since 1919, a member or chairman of many of its technical committees, and its president in 1935; and William H. Sparks, general inspector of track, Chesapeake & Ohio, a member of the association since 1919, a member of many of its technical committees, and one with an almost unbroken record of attendance at the annual meetings for the last 25 years.

One of the last items of business on the program was the election of officers for the ensuing year, in which H. E. Kirby, assistant engineer, Chesapeake & Ohio, Richmond, Va., was advanced from first vice-president to president; E. J. Brown, engineer of track, Burlington Lines, Chicago, was advanced from second vice-president to first vice-president; F. J. Meyer, chief engineer, New York, Ontario & Western, Middletown, N. Y., and a director of the association, was elected second vice-president; and E. E. Crowley, roadmaster, Delaware & Hudson, Albany, N. Y., was re-elected treasurer. F. G. Campbell, assistant chief engineer, Elgin, Joliet & Eastern, Joliet, Ill., was elected a director to fill the unexpired term of Mr. Meyer. Directors elected for full four-year terms were Cornell Halverson, division roadmaster, Great Northern, Willmar, Minn., and J. E. Fanning, assistant to chief engineer, Illinois Central, Chicago.

In moving words of encouragement and advice for the future, the new officers were installed by Mr. Clarke, who spoke first in a commendatory tone of the excellent work done by Mr. Banion in piloting the association through the difficulties of the last three years. Then, mentioning the new officers and directors by name, he spoke in part as follows:

"These gentlemen have been tried and not found wanting, and the trial has been a severe one. The past years have not been easy. There have been many difficulties to be met and it has been done successfully. The association can be proud of the part which it has played in this period of difficulty and stress. It is doubtful, however, if the next few years are going to be very much easier; the problems will be of a different kind, but very likely they will be no more easy of solution than those of the past few years. Nevertheless, I have no fear whatever but that the association will carry on in such a way that we will continue to be proud of it.

"It has been said that the railroads have no reconversion problems; that we did not have to convert when we entered the war and that, consequently, we will not have to reconvert now that we are entering a period of peace. Technically, this is probably so, in that before the war and during the war, and in the postwar period, we have been, and will be, doing the same kind of work, that is, transporting goods and people from where they are to where they are needed or where they want to be; in that sense there will be no reconversion. But I am still of the opinion that we will have a reconversion problem.

"During these past two or three years things which were previously important have been largely lost sight of, and one of those things is the matter of efficiency and cost. It has not been a question of how much it might cost to do the work, but it has been simply a matter of getting the job done. Now, we must get back to sound principles and economic thinking. Naturally, as conditions improve, we will be able to secure more efficient labor and, to some extent, that will ease our problem, but I think we will have to readjust our mental outlook and perhaps reorient our thinking. Perhaps that is a problem for this association, and is one of the ways in which it may assist the railroad industry."

In a brief address accepting the position and responsibilities of president of the association for the coming year, Mr. Kirby stated that, in view of increasing competition on the part of government-subsidized transportation agencies, the duty of all maintenance men, in common with other railway employees, is to "concern themselves with matters and movements, both economic and political, which may in the future affect our railroads," and then spoke of the importance and function of hard work on the part of the members as the only means of getting the greatest possible benefit out of the association's activities. He continued:

"Looking toward the next year, I believe we are justified in a feeling of greater confidence. You have heard the splendid reports given here today, and you have seen the excellent results accomplished by the Membership committee during the past year. This fine work was done during a year of extremely limited time for such activities. Now, if we have the full co-operation of all members, the coming year should equal or better that standard. This year will provide more opportunities, and there will be no excuse for a disappointing showing. My plea is for that co-operation. If every member will keep in mind his association's interests, the results will speak for themselves.

"When you receive at a later date the list of subjects chosen for committee reports, please study them and volunteer for service on the committees which you are best equipped to help, and then give the chairman the benefit of your knowledge and experience. Also, please remember that steady growth constantly requires new members. When opportunity offers, we should all help the membership committee by recommending every eligible non-member. The advantages will be mutual, and you will see the results reflected here next year."

Other items of business on the program included the annual reports of the treasurer, E. E. Crowley, and of the secretary, Miss Elise LaChance. The report of the secretary showed that the association has a total of 662 members, including 47 new active members and 62 new associate members added during the year.

The next annual meeting of the association was scheduled to be held in Chicago, September 17-19, 1946, and the subjects selected for investigation during the ensuing year and for report at this meeting are as follows: Selection and Maintenance of Ballast; Tie Failures and Measures for Overcoming Them; Inspection of Rail by Track Forces; Programming Work to Obtain Maximum Use of Power Equipment; Track Maintenance Problems in C.T.C. Territory; and Minimizing the Need for Slow Orders.

Field Repair and Maintenance of Work Equipment, Including Motor Cars

Committee Report

THE adequate, yet economical field repairs and maintenance of work equipment, including motor cars, is of prime importance even in normal times. Today, with our diminishing ability to employ labor, due to the critical shortage of man-power, and faced with the necessity of maintaining our roadway and structures adequately to meet the demands of war transportation, too much emphasis cannot be placed upon this class of work. Furthermore, as wage costs rise and the economic justification for complete and properly balanced mechanization increases, commensurate repairs will be essential.

The rapid expansion in the use of roadway equipment has created, and will continue to bring into being to an increasingly greater degree, the problem of maintaining this equipment in proper condition for its efficient and reliable operation. Your committee fully recognizes this, but rather than attempt within the limits of this report to give detailed and itemized instructions for the maintenance of each and every class or type of equipment, it has endeavored to set forth those overall measures that may be taken to cope with the problem, whether on a large or small railroad, and whether with few or many power machines. The measures set forth can be modified or amplified in their application to the specific problems of each road, according to the extent of its mechanization.

W. E. Chapman
Chairman

Organization

To obtain maximum results from the measures outlined, it is imperative to develop a well-rounded and co-ordinated maintenance of way equipment organization, from the individual machine operators to the highest engineering officers, to consider and act upon every factor having a bearing upon the serviceability and life of roadway equipment, beginning before its purchase and extending through the time when it is scrapped because of destruction or as a result of depreciation or obsolescence. This organization will, of necessity, be composed of the following essential subdivisions: (1) Supervisory organization, (2) operators of machines, (3) field equipment maintenance forces, and (4) shop maintenance forces.

Ordinarily, the organization is headed by the chief maintenance officer, who exercises general supervision over all maintenance of way equipment on the system. Serving under his direction as components of the supervisory organization are the engineers maintenance of way of the various general regions and the division engineers of the different superintendents' divisions, each of whom exercises general supervision over the maintenance equipment under his immediate jurisdiction.

Under this general supervisory set up are (1) the supervisor of work equipment, (2) general inspectors and field maintainers with field, office and shop duties, and (3) supervisors of track, bridge and building supervisors, signal supervisors and foremen of water supply.

Supvr. of Work Equipment

An alert and capable supervisor of work equipment is essential and is needed to co-ordinate the equipment maintenance for the road as a whole. Where such an officer does not exist, the maintenance of machines is usually left to someone whose primary interest is in some other phase of maintenance, or to a department that has little or no interest in it—a situation which creates, at its best, haphazard maintenance of equipment.

The supervisor of work equipment should be versed in the maintenance and operation of all equipment and should have executive ability and reliable mechanical knowledge. He must have the necessary authority to promulgate regulations for the care, operation and maintenance of equipment, and to enforce them. His duties should include direct control over all mechanical details of the equipment; supervision of all maintainers and operators; responsibility for the condition of all machines and for correct reports covering their condition, operation and maintenance; and the securing and stocking of necessary repair parts, tools and supplies. In addition, he should constantly carry out a specific program of recruiting and training men for operators and maintainers.

Purchase of Equipment

One of the most important functions of the supervisory organization is the selection and purchase of new or additional units of work equipment. The major problem in the purchase of machines as it pertains to field repairs and maintenance is in selecting machines that have been thoroughly tested for and that have demonstrated their practicability, dependability and simplicity of design, while at the same time giving proper consideration to ease and flexibility of operation, and, wherever possible, to standardization and interchangeability of parts. The machines should be sturdy and of sufficient strength to do the work necessary, without danger of overloading. They should have their vital or moving parts readily accessible, so that the time needed to replace worn or broken parts will not be excessive, causing unreasonable delays to gangs. The cost of maintenance can be reduced by the adoption of the fewest number of makes and types of equipment to meet the road's needs best, and the selection of those machines with stability of design wherever possible. Furthermore, they should be reliable and free of break-downs.

After the proper machines have been purchased, the problem of practical maintenance begins. One of the most important factors governing the efficient and economical maintenance of work equipment, but one that is sometimes overlooked, is that of legitimate field service from the manufacturers of the equipment.

Work Equipment Operators Should Be Selected With Care

This field service must include the instructing of operators and maintenance men in the proper operation, care and upkeep of their equipment, particularly so when the machine is the first of its kind on the railroad, or is of a new design. This service is of great benefit to both the manufacturer and the railroads, in that both parties will be sure that the machines are being used by men who know how to operate and maintain them, that they are being used on work for which they are suitable and not on work for which they were not intended, and that they are not being subjected to improper practices and abuses.

Systematic inspections by the manufacturer's service man, together with the supervisor of work equipment, should be made, regardless of the length of service of the machine. Any criticism of the machine, or any defects or weakness, will thus be brought to the attention of the manufacturer and the matter corrected.

Operators

The problem of keeping down the cost of depreciation and running repairs of equipment through proper care and operation can be solved largely by the careful selection and training of those men for operators who are best adapted by experience, physique and other characteristics for the work to be done. In addition to considerations of mental, moral and physical attributes, which are essential in all employees, the primary qualifications for operators are natural mechanical aptitude, orderliness about machinery and creative imagination. The first of these qualifications is practically indispensable. Employees having the necessary qualifications should then be given every opportunity and encouragement to obtain the necessary training and experience.

The training of operators will begin by placing them with experienced operators, for each operator should have an understudy who is learning to handle the work and who can take over in case he is incapacitated, promoted, or is away from the job for other reasons. During the training period, the apprentice should familiarize himself with the manual of instructions that pertains to the particular machine with which he is working. The operator must teach him the proper work to be done by the machine, its capacity, and the need for cleanliness and proper lubrication. The beginner must be taught by lucid demonstrations and concise instructions how to dismantle, clean, make light repairs to and re-assemble the machine as quickly as possible. The operator should be sent to the shop with the machine when it is scheduled for overhauling to assist in the work.

Maximum service from equipment will be secured only when proper emphasis is placed on field repairs by the operator while on the job. The beginner must be taught that he must keep the machine clean and properly lubricated, and that all bolts must be kept tight at all times, as these factors are essential to maximum efficiency of the machine. In fact, it should be pointed out that these factors form a criterion by which he will be judged, as they indicate the degree of care that is being given to the machine. He should also be taught to make necessary reports and should be placed as machine operator only after his qualifications are proved through an examination by a maintainer or the supervisor of work equipment.

Cleanliness—Lubrication

Cleanliness of the machines can and will eliminate many repairs which are caused by neglect or misuse—repairs which are not only costly in themselves, but which contribute to untimely breakdowns that cause expensive delays through the disorganization of gangs. A good operator does not allow his machine to remain in a dirty condition, as such neglect will make it difficult, if not impossible, to inspect the machine satisfactorily or to find defects that need correction.

The necessity for prolonging the life of our roadway machines requires us to see that they are given proper protection. No feature of the operation of power machines is more conducive to the conservation of materials and to prolonging of life of these machines than proper lubrication. Adequate lubrication, however, entails more than mere "oiling around" or keeping the crankcase full of oil. It requires the application of the right type and grade of lubricant, and in the manner recommended by the manufacturer at regular stated times. Oil should never be applied where grease is required or grease where oil is needed, and both the oil and grease should be suitable for the particular bearing upon which it is to be used. Specialized lubrication is mandatory for the proper maintenance of equipment.

Lubrication charts, showing the type of grease or oil and the equipment part on which it is to be used, should be posted on, or handy to, the various machines for the guidance of the operators. These charts should be kept up to date, showing the dates that the machine is lubricated, oil is changed, and the amounts of oil or grease used.

Frequent checks must be made to see that oil levels are correct. Care must be exercised to be sure that an excessive amount of grease is not forced into the housings by means of a pressure gun or compression cup, as this is a frequent cause of bearing failures. Too, the expansion of the heated grease may be sufficient to crack the housing.

It is important that the operator call upon the maintainer or repairman promptly if the machine is not in satisfactory operating condition and he cannot repair it himself. Attention must be given to the machine by the operator and maintainer at the first sign of trouble. This will result in better performance and longer life for the equipment and will prevent irreparable damage.

Just as "oiling around" is not sufficient, so the use of "just oil or grease," without attention to grade or type, is inadequate. With machines of many types, sizes and makes, many types and grades of lubricants are required. The need for keeping the number of types and grades of these lubricants in the store stock to a minimum is recognized, but, to avoid unnecessary wear of parts and to insure continuous service, it is essential that for each piece of equipment lubricants be furnished that are of the grade and quality recommended by the manufacturer. Much research and long and expensive tests have been conducted by both the equipment manufacturers and the oil companies to determine the correct lubricant for each wearing part.

Reports

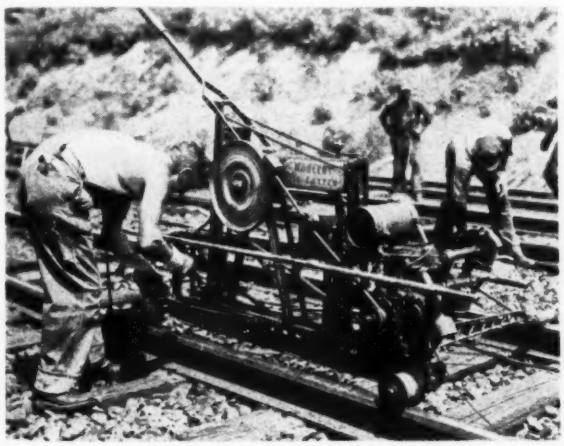
Periodic reports relative to the condition of the machine should be made by the operator. It is recommended that these reports be specific and apply to but one type and class of machine, and they should contain such data as will enable definite cost records to be established and maintained. Uniform records of inspection and costs of maintenance and operation are indispensable in determining the most economical and efficient type and make of equipment, and in indicating the expense justifiable to maintain the equipment in condition for service or to replace it. Such records will also indicate whether an organization is operating efficiently.

Mechanical vs. Maintenance Shops

Inevitably, the discussion of maintenance of work equipment brings up the question of what department shall maintain it. For most of the roads this question is answered by existing agreements with various craft unions. However, believing that the most practical and effective use of work equipment can be obtained by requiring the department that uses it to maintain it, we recommend that the equipment maintenance organization be developed within, or as an adjunct to, the maintenance of way department, along system, regional and divisional lines. Hence, it is immaterial whether the mechanical or maintenance of way department employees maintain the equipment, as long as the organization set up for this purpose is attached to and under the direction and supervision of the maintenance of way department.

This organization should supervise and be responsible for the proper maintenance of all units of work equipment used in maintenance of way work, including the steam and MCB equipment or units which come under the safety rules of the Interstate Commerce Commission. Obviously, to avoid duplication of heavy shop machinery, and because the heavier equipment is usually assigned to the mechanical department for repairs, this department should do the heavy shop work on the steam and MCB equipment.

The field maintainers form the foundation of the equipment maintenance organization and, as such,



Work Equipment Operators Must Have A Natural Aptitude for Mechanical Matters

ROADMASTERS

should be selected and trained in a thorough and systematic manner. Diligent search should be made to secure the best men available for these positions, whether from the ranks of the operators of machines, the shop forces, or from outside shops. The qualifications are the same as for operators, but with the added one of longer and more extensive experience in operating and maintaining roadway machines.

The number of field maintainers needed for each division ranges from one to many, depending upon the extent of the mechanization of the road involved. Oftentimes the division field forces will be headed by a foreman, who will have the required number of field men working under him, out from a division shop.

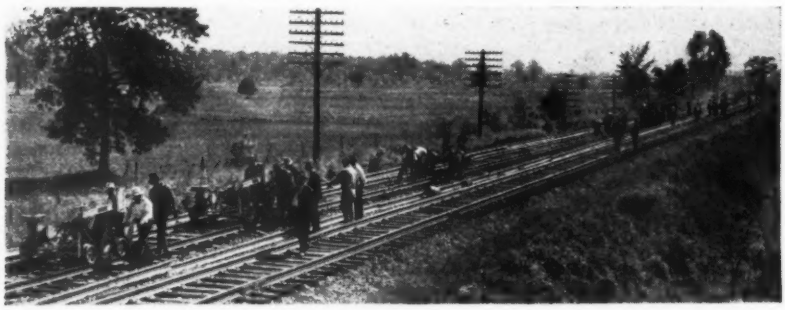
Capable and efficient maintainers are essential to an effective organization and they should be encouraged to seek further education and training in their work from all sources possible. This training, naturally, begins by working under experienced equipment maintainers in the field and shops. They should be sent, where possible, to study in the shops of manufacturers. Other training and knowledge can be secured from manufacturers' servicemen, correspondence courses and trade periodicals.

The duties of field maintainers that are deemed fundamental include, (1) the training of operators in the proper use, operation and care of the machines, (2) the determination of the condition of all machines by periodic inspections, (3) the acquisiton of replacement parts for anticipated repairs, and (4) the making of field repairs to the machines. The work of the maintainer should be preventive rather than corrective, if possible, which can be brought about by making the inspections not only more thorough, but at more frequent intervals than is now the practice on most roads, and by the anticipation of minor running repairs or the need for a general shop overhauling.

Where many units of equipment are used with large gangs, a maintainer should be on hand at all times to make needed repairs promptly as required, and to prevent undue and expensive delays to such gangs.

To facilitate the maintenance of equipment in the field, the field maintainers should be furnished with means of rapid transportation to points of trouble and for making

their regular inspection trips. This means of transportation for maintainers, tools and parts, can be of many different types. The use of highway types of motor equipment, such as a light panel delivery truck or a truck with a standard installation body, is recommended in localities subject to congestion and



Gangs Using Many Machines Should be Accompanied by a Field Maintainer

dense train movements, particularly where highways are convenient to the railroad lines.

Where traffic conditions are more favorable for rail operation, or where highways are not readily accessible, motor cars can be used. Where rail operation is advisable, the maintainer should have a tool car, properly equipped, and a living car to be moved to points where he is needed, or where he will be working. Among the disadvantages of the truck are the loss of track patrol, difficulty in securing fuel, and failure to make full use of the truck.

When trucks are deemed desirable, the vehicle selected should, when possible, be of a design and type that will adapt itself to the many operations of this class of maintenance work. They should be equipped with chain hoists, socket wrenches, electric drills, gasoline-driven pumps, gasoline generator plants, and any other special equipment required for field repairs. In addition, hand tools characteristic to the equipment on which the maintainer works must be supplied.

Special compartments or bins should be constructed in these trucks or cars for storing repair parts of the kinds and number that are anticipated to be needed.

Repair Parts

An adequate supply of repair parts on hand is necessary to service equipment properly. When a machine is out of service for lack of a part that is worn or broken, a decided falling off of production by some gang can be anticipated. When the field maintainer does not have the part necessary, there is some delay, but when that part cannot be secured from the store's stock by baggage or express shipment, and must be secured from a manufacturer, possibly a thousand miles away, who can only make delivery when he gets a long-delayed shipment from some other manufacturer, and who must meet priority requirements, you may expect from one week to several months idleness for these machines. Hoarding is not advocated, but the protection of the operation of our machines by maintaining a suitable stock of replacement parts at our stores is strongly recommended.

"Make It Do"

Parts should be stored centrally and arrangements made for their rapid distribution. Where several machines work together as a unit, the spare parts to be kept on hand at the site of the work should include entire engines, transmission units, and the like. In some cases, complete spare machines are justified in order that the progress of the gang shall not be impaired by a machine failure.

In these days of shortages, we often have to "use it up and make it do," and, consequently, run our machines longer than we should before repairing them. These shortages can be alleviated somewhat by salvaging all old parts possible for reuse in other machines. While this reclamation of parts is desirable at all times, it is a necessity now. The stock of old and new parts should be checked frequently to be sure that sufficient parts are on hand and to assure the management that there is no excess over what is actually needed for necessary repairs.

Replacements

Work equipment should be rereplaced as soon as it has passed the limit of economical maintenance. The criterion for replacement will vary with different classes of equipment, but generally speaking, work equipment should be replaced when the annual cost of maintenance of old machines exceeds the carrying charge on newer and better types. Today, however, the criteria selected for the replacement of both obsolete units and those with a high maintenance cost must always be based on the ability of the machine to perform the work more cheaply and effectively than can be done by hand labor.

Obsolescence, as it effects the maintenance of equipment, is usually caused by the difficulty or impossibility of securing proper replacement parts, and equipment should be replaced when it becomes obsolete for this reason.

It is readily apparent that it is extremely difficult to cover the many angles of application of the above measures or principles in such a way that the information gathered can be applied generally to all conditions. In fact, such data must necessarily be of a general nature and the applicaton involved must be fitted to the needs of each individual railroad. However, it is the

A Standard Installation Body Type Truck—One of the Types Found Well Adapted to Use by Equipment Field Maintainers

hope of your committee that the methods set forth in this report, when applied to specific situations and interpreted in the light of conditions on each road, will be of material aid to those involved in the maintenance and repair of work equipment.

Conclusions

The economical and efficient field repair and maintenance of work equipment, including motor cars, is dependent on many factors, such as:

(1) The creation of an effective organization to handle the work equipment.

(2) The purchase of dependable machines adapted to the work to be done.

(3) Co-operation by the manufacturers of the equipment.

(4) The competence of the operators and field maintainers.

(5) The extent and persistence of supervision over all phases of the operation and maintenance of equipment.

(6) The equipping of maintainers properly.

(7) Adequacy of lubrication.

(8) The ready availability of a sufficient supply of lubricants and repair parts.

(9) The reclamation of any usable parts.

(10) The replacement of machines promptly that cannot be maintained economically.

(11) The adoption of a "stitch in time," or preventive, policy in maintaining the equipment.

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Discussion

In the absence of W. E. Chapman (C. of Ga.), chairman of the committee, this report was read by C. Halverson (G. N.), vice-chairman. The discussion was initiated by C. H. Mottier (I. C.) who, saying that he was speaking from the managerial point of view, stated that two of the most important points to be kept in mind when considering work equipment are (1) to obtain maximum usage of available equipment, and (2) to provide proper facilities for storing and repairing such equipment. Referring to that portion of the report relating to obsolescence of equipment, G. E. Boyd *(Ry. Eng. & Maint.)* stated that an important consideration not mentioned in the report is whether the equipment on hand is capable of doing the work as cheaply as improved types that may be on the market.

Modern Methods of Right-of-Way Grading and Drainage

Committee Report

A. G. Reese
Chairman

BEGINNING with the earliest American railroads, it was established that the first essential in the construction and maintenance of an adequate track structure was to build a compact subgrade and then to preserve it under ever-increasing loads and speeds.

Much study and discussion have been given since to the drainage, stabilization and reinforcement of this subgrade, because in many instances, while subgrades were built entirely adequate for the traffic and speeds prevailing at the time of construction, they have since failed under the heavier loads that the railroads have been called upon to carry.

On many of the main lines of the United States, little realinement of the track from its original location has been necessary to care for this increased traffic. This is a result of the remarkable work done by the early locating engineers. But while this must be regarded as a distinct engineering triumph, other results have not been so good. Conditions developing from the continuation of these lines with the prevailing methods of maintenance have caused maintenance officers no little concern.

The equipment available prior to the last decade did not permit construction methods which are now regarded as standard. Cuts were excavated to slopes of 1 to 1, and usually no wider than necessary to accommodate the track and an entirely inadequate side ditch. Fills were usually constructed with earth from borrow pits or with material excavated from cuts, deposited on the fill from a construction trestle. This method of construction resulted in recurring slides in cuts and on fills, necessitating continual restoration work.

Maintenance of these early roadbeds consisted of ditching the cuts with on-track excavators and transporting the excavated material to adjacent fills in dump cars, where it was deposited to restore the fill to somewhere near its original lines. By this operation, a dual benefit was realized in that drainage of the cuts was improved and the fills were strengthened.

However, this method of maintenance has long since reached the point where it can no longer be continued economically on most important main lines. Furthermore, increased traffic

Left — Motor Patrols Are Used for Grading Shallow Cuts. Below — Right-of-Way Grading with Tractor-Drawn Self-Loading Scrapers

has limited the working time of on-track dirt-moving equipment to such an extent that delays aggregating three to five hours a day for work trains and corresponding delays to revenue trains have not been unusual. Also, cuts have been ditched out as far as on-track equipment can reach, with the slopes left in a more or less perpendicular position at the bottom, impairing the foot of cuts where they should be best maintained. Fills have been overloaded by continual deposits of earth, without proper slopes, since no means of establishing easy slopes were available. Limited finances in the past retarded the development of equipment to handle this work in any other way, and old practices were continued far too long, with the result that the railroads have been plagued with an epidemic of slides in cuts which have often blocked the railroad, and slides on fills which in many instances have undermined the track, interrupting traffic for days, and sometimes for weeks.

The narrow and deep cuts were also "made to order" for snow blockades, and all maintenance men in cold climates can recall cold and weary hours spent in an effort to release trains stalled in these snow-filled cuts. Since drainage was inadequate, the water from melting snow was not carried from the cuts in the side ditches, but rather seeped into the ground to become a later source of more trouble.

The depositing of impervious materials on fills also contributed to the creation of water pockets, and their presence in fills has been one of the principal causes of slides where the fills are overloaded. The extraordinary maintenance of the track over a few hundred feet of these water pockets has often exceeded the entire maintenance for a mile of adjoining track. Speed restrictions resulting from this condition have often proved a serious handicap in the operation of present-day heavy-tonnage trains.

These, with many other conditions constantly developing on the modern railroad, indicated clearly that improved methods of grading and of maintaining the right-of-way had to be devised if present traffic and speeds were to be maintained with the limited forces available.

Modern Methods Developed

To the United States Bureau of Roads must go much of the credit for the development of modern methods of grading and drainage. With the unlimited resources of the United States behind it, and the experience of grading engineers, many of whom received much of their practical knowledge on railroad projects, the bureau developed new methods and new equipment for the construction and maintenance of our great network of highways.

Railroad engineers have not overlooked the success of these new innovations and have adapted many of them to the construction and maintenance of the railroad roadbed and right-of-way. The practices, modified or enlarged upon to care for the heavier loads carried by the railroads, have been used very successfully by many railroads during the last few years to correct the unsatisfactory conditions that have been referred to and to prevent the development of more such conditions in the future.

Within the last few years dirt-moving equipment of the latest design has become available and is now being used to capacity in grading the right-of-way. Cuts are being sloped to an easy grade of about 4 to 1 wherever possible, thereby eliminating to a great extent the danger of slides, and resulting, in most instances, in a section of right-of-way that can be maintained with off-track equipment and mowed from fence to fence with tractor mowers.

In most instances where the cuts were comparatively shallow, they have been practically eliminated, often improving the visibility at highway crossings. Instead of excavating side ditch for drainage, cuts have been dressed to a concave surface with their maximum depth as far from the track as possible. In shallow cuts where sufficient right-of-way is available, this is usually not less than 20 ft. from the center line of the track. Earth removed from these cuts has been transported to adjacent fills, used to fill old barrow pits, or wasted in low spots on adjacent property.

Standard cross section plans have not been made up, except for minimum specifications, since each location requires different remedial treatment. The width of the subgrade under the ballast section has been standardized at 24 ft. for single track and 12 ft. from the center line of outside tracks in multiple-track territory. Elevation of the crown of the subgrade has also been established to permit the use of the standard ballast section, which greatly improves drainage of the ballast, reducing the tendency for the ballast to puddle or churn.

Resloping of Cuts

Present-day methods of grading shallow cuts involve the use of bulldozers, angle graders, carryalls, gasshovels, trucks, motor patrols, etc., the number and kind of units employed on any particular job, and their capacity, being determined by the quantities of material to be moved and the length of haul. An on-track spreader is usually used in advance

of the grading to establish the grade at the toe of the ballast section and to avoid the necessity for the off-track grading equipment working in close proximity to the track, since all of this work is done without the protection of slow orders. After the face of the cut has been brought to approximate grade, the surface is finished with a motor patrol. The result is a surface which carries water from the track to a shallow channel at a safe distance from the track, and a cut which offers little opportunity for snow to lodge and drift.

Deeper cuts have received different treatment, depending upon their depth and length. The quantities of material to be moved and its disposition govern the methods and equipment used. Ordinarily, where the depth of cuts is from 25 to 75 ft., the adjacent fills are also very high and are usually already overloaded with the earth removed from the cuts with steam ditchers. Too often, also, the faces of these cuts are sloped 1 to 1, and the quantities to be moved in flattening these slopes are very great.

In many cases of this kind, a very successful practice has been to place a dragline on top of the cut and excavate the face to the desired slope. In extremely deep cuts it has been necessary to bench the face to facilitate the work, making two or more casts. Excavated materials are deposited on top of these cuts, far enough back from the edge to offer no increase in the overload, which might increase the tendency to slide. Bulldozers are frequently used to assist in the disposition of this material by spreading it over a considerable area.

Where the use of draglines has not been practical, shovels have been used to excavate to the desired slope, the material being transported by truck to a convenient waste pile. Also, in locations where adjacent fills will permit the unloading of additional earth, spreader ditchers have been used in conjunction with bulldozers, the bulldozers working on the face of the cut, pushing the dirt to the track edge, where the ditchers can carry it out on the fills. Slopes of at least 2 to 1 are striven for in all such cuts. Dressing of the subgrade in these deep cuts conforms to the standards established for shallow cuts, with the exception that a ditch is provided outside the crown of the subgrade.

Restoring Fills

In restoring fills, construction is to a slope of at least 4 to 1 wherever possible, and restoration starts at the bottom of the fill. Furthermore, the original slope is benched as each succeeding layer of earth is deposited. This insures a compact fill with no seams or marks between the old and new portions of the fill.

Often when this work is in progress, old water pockets are encountered and successfully drained temporarily. However, since the main portion of the pocket is under the track, no lasting benefit can be expected. The material used in this work is usually excavated from adjacent cuts where available, although borrow pits are sometimes resorted to. These restored fills are well compacted by the continual movement of the construction equipment, and their slopes are finally dressed by the motor patrol to secure a uniform and smooth surface.

On extremely high fills, it is neither practical nor economical to provide slopes as flat as those on lower fills. In a considerable number of such cases, a very successful practice has been to construct a heavy, well-compacted berm at the toe of the slope. Also, in a number of instances where slides have occurred on these high fills, a dragline has been used to excavate a trench at the toe of the slope, also cutting away a portion of the lower part of the fill. This trench was then filled with riprap, riprap also being used to restore the material removed from the fill. The earth removed was then cast back on the fill to restore it to the desired slope. In several instances where this procedure has been carried out, there have been no slides since the work was done two years ago, in spite of the fact that precipitation during these years has greatly exceeded normal. Furthermore, where it was previously necessary to raise this track each week, spotting since the fill restoration work has been limited to the usual maintenance work prevailing on adjoining sections of track. No restrictions on speed have been necessary since this work was done, whereas slow orders were very frequent before.

Where the right-of-way has permitted, surface ditches have been provided back from the tops of the cuts, and these in conjunction with channel changes of creeks and streams near fills have resulted in keeping water away from cuts and fills. It has been found that in most instances adjoining property owners, if approached properly, will co-operate in making available the necessary right-of-way and in securing authority for this work. This control of water beyond the property line of the railroad will often prevent washins and washouts, with their consequent damage and delays to traffic.

ROADMASTERS

Right — Widening an Embankment with a Tractor Shovel. Below — Similar Work with a Bulldozer

Since most of the classes of work described have been done only during the last two years, it is rather difficult to evaluate all of the benefits derived. However, there have been results that demonstrate clearly that the methods now being employed have and will continue to accomplish many improvements in the maintenance of the railroad track structure.

In locations where side and cross washes were frequent in the past, due to narrow cuts and inadequate side ditches, before grading operations were completed, rains of cloudburst proportions have since been experienced without damage to the track. Under the new conditions, the water has flowed away from the track to the lower part of the right-of-way provided by the grading, and then out of cuts or away from fills at a safe distance from the track. The contour of the right-of-way retards scouring and consequent damage.

Example of a Right of Way that Has Been Graded in Accordance with Modern Practices

Surface ditches and channel changes permit faster run-off, diverting the water away from the track, and it is reasonable to expect that they will greatly reduce, if not prevent entirely, side and cross washes.

Sloping of the crown of the subgrade away from the center line of the tracks has greatly facilitated the drainage of the ballast section and has resulted in a material reduction in maintenance. Well-drained ballast will not become foul, with consequent puddling and churning of joints. It has been found also that track will continue in proper alinement and surface much longer in districts where this work has been done, than in districts on the same line which have not been graded and conditioned.

Shimming of the track during the winter season has been reduced to the minimum. In areas where a great number of shims were necessary before grading, practically none have been necessary since. Since well-drained slag or rock ballast can be spotted up even in zero weather, it is reasonable to assume that enormous savings in labor can be realized by the avoidance of shimming, and also that considerable savings will accrue through the increased service life of crossties, which soon become spike killed from the spiking of shim braces.

The daylighting of highway crossings, which has been taken care of in connection with many grading operations, has undoubtedly prevented many crossing accidents, and in addition has reduced maintenance of the track and crossings by the improved drainage condition brought about.

The drifting of snow in cuts has been reduced, with a consequent reduction in train delays. The necessity for maintaining many miles of snow fence has been eliminated, with material savings in the expense incurred by the installation, dismantling and storing of these fences each year.

Improved visibility has been gained throughout the territory graded, reducing the hazard of accidents to motor cars and work equipment, and a further material reduction in the number of these accidents can well be expected.

The elimination of the causes of slides and washouts will improve the overall on-time performance of trains.

These are only a few of the benefits being derived from modern methods of right-of-way grading and drainage, and while it is difficult to assign a definite monetary value to this class of work, future results will undoubtedly prove that such work is resulting in some of the greatest improvements made to the railroad roadbed in many years.

To insure efficient work and the desired results in the various types of grading described, it is necessary that there be complete understanding and co-operation between engineers, the roadmaster, and those doing the work. An aggressive, ambitious roadmaster can and will secure results which will produce savings in maintenance and in operation as long as the railroad continues to operate in the territory where the work is done.

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Discussion

N. D. Howard *(Ry. Engr. & Maint.)* suggested that many railway officers are not convinced that the grading of the right of way in the manner set forth in the report is desirable as a general policy, in view of which, he said that the advantages inherent in this type of work should be promoted actively by maintenance-of-way officers. President Banion said that he foresaw a marked trend toward the use of off-track machines

Embankment Restoration With a Dragline

where the grading of the right of way has been undertaken, because of the facility with which the work can be done with this equipment, without interfering with traffic.

C. H. Mottier (I.C.) doubted the advantages of a general practice of roadway grading beyond that which has a definite bearing on improved track conditions and reduced maintenance. He said that it was clear in his mind, however, that there are distinct advantages in such work at and adjacent to highway grade crossings, in widening cuts and strengthening fills, and in improving drainage away from the track, but that he questioned the value in many cases of carrying the work out to the right-of-way fence.

Chairman Reese expressed the belief that the practice is well worth while, and stated that both maintenance and executive officers on his road are convinced of the benefits of this class of work, particularly in connection with securing a more stable track, in simplifying weed control, and in the reduction of snow trouble.

He cited the experience of the Burlington with rainfall of cloudburst proportions, which occurred at several points during the present year in territory where regrading of the right of way had been undertaken, and said that all strengthened and resloped embankments shed the water without damage, and that no repairs or restoration had been necessary.

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Mr. Mottier inquired whether the Burlington is cutting all weeds or only noxious weeds, to which Mr. Reese replied that all noxious weeds must be cut to conform to the laws of the states through which his road passes, and that there are so few places and such short intervals where some noxious weeds are not found that all weeds are beng cut. Mr. Mottier expressed his belief that by cutting only the vegetation absolutely necessary large savings can be achieved.

Prevention of Damage to Rail

Committee Report

J. E. Fanning
Chairman

THE demand for steel for various purposes since the beginning of World War II has prevented delivery to the railroads of sufficient rail to meet their abnormal requirements resulting from the wear and breakage caused by the unprecedented volume of traffic handled. The subject assigned to your committee, therefore, is one of intense interest to maintenance of way men. In fact, the supply of new rail is so limited that it must be carefully allocated and applied where the need is most urgent. Furthermore, it is imperative that the usefulness of new rail, as well as of that of rail now in the tracks, be carefully preserved. This can best be done by exercising extreme caution in unloading and laying it, and thereafter maintaining it according to the best known practices.

Must Study Causes

If damage to rail is to be prevented, careful consideration must be given to the different ways in which it occurs. Some of them are quite obvious; others may not be detected until actual failure takes place. As an illustration, damage caused by a broken wheel becomes evident almost immediately, while a web fracture due to spike maul blows may not become apparent for some time after the blows have been struck.

Many articles have been written on the broad subject of rail damage and intense studies have been made of its different phases, with the result that there is little this committee can report that is new; nevertheless, a discussion of some of the things that happen to rail and of some of the practices that may eliminate or minimize damage to it is quite timely.

For the consideration of the association, the committee submits some of the most common causes of damage to rail as follows:

(1) Derailed wheels striking rail anchors, damaging the base; (2) broken wheels nicking the rail head; (3) driver-wheel burns; (4) unbalanced locomotives, causing kinks or fractures; (5) flat wheels under heavy loads; (6) improper loading, unloading and handling; (7) lack of support at joints, due to—(a) loose bolts, (b) drooped or bent joint bars, (c) cocked joint bars, (d) cracked joint bars, (e) worn joint bars or worn fishing surfaces, (f) poor joint ties, (g) poor ballast, and (h) poor drainage; (8) loose tie plates; (9) insufficient number, inefficient quality, or poorly applied rail anchors; (10) insufficient lubrication on curves; (11) gravel on rail at highway crossings; (12) corrosion of rail at highway crossings and in tunnels; (13) incorrect gage; (14) incorrect methods of cutting rail; (15) failure to build up or grind battered ends soon enough; (16) end hardening in track improperly performed; (17) failure to shim heaving track properly; (18) spike maul blows on rail web; (19) not transposing rail on curves soon enough; (20) improper superelevation; (21) use of expansion shims of improper thickness; (22) use of torch to provide bolt holes; (23) brine drippings; (24) extensive use of sand by locomotives on switching leads and heavy grades; and (25) false flanges on cars and locomotives.

Other causes might well be mentioned, but a discussion of the foregoing will suffice to stimulate interest in this matter and cause additional ways to be devised to bring about an improvement in preventing damage to rail. No doubt, every member of this association has witnessed the destruction of vast quantities of rail from one or more of these causes.

When a car is derailed by "rocking off" because of being improperly loaded, because of having excess side bearing clearance, or because of uneven track surface, it may, and fre-

quently does, travel a considerable distance along the edge of the rail base, striking rail anchors, bolts, etc., with the result that much rail is immediately ordered to the scrap pile. In addition to the loss of the value of the rail, the labor required to make the replacement reduces the amount of productive work accomplished.

Head and Web Separations Are a Defect Commonly Found at Road Crossings

Nicks in the head, caused by broken wheels, are, generally speaking, not as serious as damage to the base of the rail. Most head nicks will wear off and cause no permanent damage, but slow orders should be maintained for several days until all scars are examined. If derailment of a broken wheel occurs, however, and the base of the rail is nicked, immediate removal is recommended. Good judgment is required in selecting rails with nicked heads that are to be removed.

The effects of engine burns are very undesirable, although, unless quite severe, they do not make rail unsafe for further use. They occur more frequently near coal and water stations and other places where frequent stops are made and where it is hard to start a heavy train. Comparatively little has been done to repair rail damaged by engine burns.

There has been less damage during the last few years than previously from unbalanced locomotives. This is due in some measure to the installation of scales for weighing individual drivers. Furthermore, the methods of design of locomotives have improved and Diesel power is coming into general use on high-speed trains. It happens, too frequently, however, that a quantity of rail is damaged by a locomotive being operated or towed at an excessive rate of speed with its side rods down, spring rigging inoperative or otherwise in an unbalanced condition. This is usually due to an oversight, but damaged rail is nevertheless the result.

The effect of flat wheels under loaded cars is not noticeable at once, but frequently is sufficient to cause initial fracture and subsequent total failure.

The extended use of rail cranes has eliminated much of the danger of bending and permanent distortion of rail during the process of loading, unloading and laying. In distributing rail preparatory to laying, it is essential that it be properly supported, and care should be taken to place it on reasonably level ground.

By far the greatest amount of damage to rail caused by traffic occurs at the joints. Therefore, extra care in maintenance of rail joints will increase the life of rail substantially. Butt welding illustrates how much longer rail could be used if it were not for the existence of the joints.

The use of power bolt tighteners permits more uniformity in bolt tension, and minimizes the number of loose bolts, but, nevertheless, it is necessary to adopt a systematic program of tightening to keep bolts tight.

Methods of flame straightening rail ends and reforming angle bars are in general use and have contributed substantially to improving the condition of rail joints. It is economy to purchase reformed or new bars when the fishing becomes badly worn.

Poor ties, foul ballast or insufficient drainage have long been recognized as detrimental to the life of rail. Money spent for better maintenance, including line and surface, will reduce the cost of rail.

When laying rail, special care must be taken to see that it is properly seated on the tie plates, and at no time should plates be allowed to become loose enough for the shoulder to get under the rail base, as base fractures and moon breaks may occur.

It is necessary to maintain equal and adequate allowance at the rail ends for expansion, to prevent battered joints or chipped ends. When laying rail, the use of expansion shims of proper thickness and the immediate application of sufficient rail anchors are essential. The anchors should be of an efficient type and care must be taken to avoid damage to the base of the rail in applying them. The rail ends should be properly lubricated with either a good grade of oil or an approved joint pack at the time rail is laid. Unless rails are properly lubricated on curves, accelerated side wear on the head takes place. There are several types of lubricators in general use and their value in preventing rail wear has been established. The proper number and location of these lubricators for a given territory should be ascertained from an analysis of all conditions, such as curvature, grades and nature of traffic handled. It may be necessary to relocate them at least once to secure the best results.

Gravel on Rail

The effect of locomotives and cars passing over loose gravel on the rail at highway crossings is more disastrous to the life of rail than is generally appreciated. Apparently, stresses are set up in the rail which cause the ball to separate from the web, creating a dangerous condition that is not easily detected. Extra care should be taken therefore, in inspecting rail in crossings. The condition is aggravated by corrosion, and some railroads have gone to considerable expense to flame clean and oil rails which are to be used in highway crossings to minimize this corrosion. This novel treatment is justified by the number of head and web separations that have developed.

Example of an Engine-Burned Rail

Tight gage may cause head checks, which subsequently develop into detail fractures, while gage that is too wide throws the wheel bearing too far to the inside edge of the head. In addition, it causes accelerated side wear on the head.

Cutting rail with a torch, without proper pre-heat, leaves a hard layer at the cut which cracks on cooling and sometimes spreads into the web. Incorrect methods of cutting rail are a source of considerable scrap.

It is particularly important that the ends of rail be beveled, either at the mill or in the field, to prevent chipping from overflow of metal. Battered ends should be built up before they reach the stage where cracks develop.

Many broken ends have resulted from failure to follow the practice of building up or grinding ends frequently.

Spike Maul Blows

Investigation has developed that many rail failures can be traced to spike maul blows against the side of the web. This is most likely to occur while rail is being laid or during the process of gaging, and the effect is intensified if the weather is cold. Web cracks have been known to develop and cause ultimate failure of the rail, even though the maul left no mark to identify the cause of the fracture. A plan of education to acquaint trackmen with the crystalline nature of rail, describing how readily it can be broken after being nicked or subjected to blows, should produce valuable results.

Under certain conditions it is economical to transpose rail on curves, in which case it should be done before wear becomes excessive.

Improper superelevation results in excessive flattening of the inner rail, or excessive wear on the outer rail. By observing the amount and nature of wear on curves, it is possible to determine if an adjustment in the superelevation is advisable.

The burning of holes in rail with a torch has been prohibited on most roads for a long time. Supervisory forces must always be on guard to preclude the possibility of this being done by someone not familiar with the bad results that usually follow such practice.

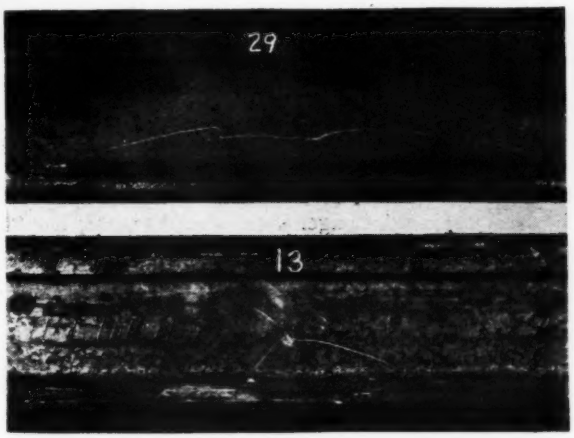
One of the most serious problems in preventing damage to rail is caused by brine drippings. The corrosive action of such drippings can be retarded by the liberal and frequent applications of oil over the entire surface of the rail, except the ball. It may be that mechanical refrigeration or the application of brine retainers on refrigerator cars will be the ultimate solution to this problem, but at the present time we must depend upon the use of oil.

The excessive use of locomotive sand by enginemen is almost as damaging as not using enough. There is a tendency to keep the sanders on locomotives open almost continuously while switching, with the result that the base of the rail and tie plates are soon buried. Unless frequent cleaning is done, damage to the rail and fastenings results. The same is also true on heavy grades. A thorough saturation of the rail with a heavy grade of oil after cleaning will prove beneficial.

As soon as the treads of car or locomotive wheels become worn and develop so-called "false flanges", they begin immediately to take their toll in rail wear. Investigation may develop that shelly spots on the head surface is, to some extent, due to worn wheels. It is safe to say that the better the condition of wheel treads, the longer will be the life of rail.

Those of us who are engaged in roadway maintenance work should, at every opportunity, observe rail that is being removed from the track and analyze each failure to determine whether the rail has been abused by neglect or other cause. By so doing, we may be able to prevent similar failures in the future.

The constant maintenance of a well-coordinated track structure, as well as of the roadbed on which it rests, is essential if we are to obtain the maximum life of rail, and thus make our greatest contribution to the war effort.



Two Examples of Web Cracks Caused by Blows From Spike Mauls

References

For the benefit of new employees and others who may desire a broader discussion of some of the above phases of rail wear or damage, the following references are given:

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ROADMASTERS

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Discussion

President Banion inquired whether the committee's investigation developed information whether driver-kinked rail should always be removed immediately from the track. Chairman Fanning replied that no cases of rail failure were reported as a result of driver damage, but that in some cases the track was left so badly out of surface that it became necessary to remove the rail for this reason.

E. W. Backes (Carnegie-Illinois Steel Company) cited mention in the report of the crystalline structure of the steel, and explained that while steel has a crystalline structure it does not crystallize as many trackmen believe.

F. G. Campbell (E. J. & E.) brought up the question of welding driver burns. The discussion disclosed that a number of roads, particularly in the East, are welding these defects. It was pointed out, however, that the roads doing this work are careful to grind the damaged metal out before welding and are confining the practice to the 131-lb. section. H. R. Clarke (C. B. & Q.) called attention to the studies of this subject that are being made by the A.R.E.A. to determine whether the practice is safe. "Tests are being made," he said, "by rolling-load machines, but the process is slow because of the limited number of these machines available." Mr. Clarke also called attention to failure of the committee to mention the end hardening of rail, because he believed a discussion of this subject would have been well worth while.

Damage to rail by striking the web with mauls then came under discussion and it was emphasized that the damage from this cause occurs by reason of overstressing the metal, and that the resulting cracks progress to their full extent almost immediately after the blow is struck. It was also shown that if the blow is struck by the flat of the striking surface there may be no maul mark on the surface of the web, but the damage occurs just the same. It was the belief of all of those who participated in the discussion that this information should be given to all trackmen.

Stabilization of Roadbed

Committee Report

J. R. Rushmer
Chairman

UNSTABLE track, variously called "water pockets," "soft track," etc., and which includes embankment slides, is found in all climates and under all types of traffic. It is the result primarily of a soil condition, and is not confined to ballasted track, but frequently occurs in both unballasted main and yard tracks.

Free water is not necessarily present in the roadbed in unstable track. Quite often the unstable condition is the result of the voids in plastic material being full, or nearly full of water. Frequently a balance is maintained, so that this wet condition remains nearly constant in spite of variations in rainfall.

When the roadbed becomes unstable, the ballast or surfacing material is driven down into the roadbed by traffic, providing additonal water storage space and permitting free water to be held in the ballast section during a part of the time, or in some cases the year around. Water held in cuts may rise due to rainfall or springs and may flow down the ballast section for considerable distances. Ballast penetration of 15 ft. or more has been known both in cuts and on fills.

Turbulence induced by traffic causes water held in the subgrade to wash the soil material and to knead plastic elements of the roadbed, which then become saturated and at the same time impervious to the passage of water. The washing effect sometimes coats the upper ballast with soil material and results in "pumping track," but pumping track does not necessarily contain water pockets.

Generally, the unstable condition results in deformation of the roadbed, but not always. "Squeezes" or "heaves" are the most common indications of unstable roadbed condition, these sometimes being built up above top of rail. Removing these heaves without any other treatment is not advisable. Unstable track is costly to maintain, and may be hazardous. Furthermore, in spite of the excessive amount of labor that must be spent on surface and line, the track seldom has desirable riding qualities.

Many methods have been used in attempts to stabilize soft roadbed, and, no doubt, all of these methods possess some advantages. No one method is adaptable to all conditions.

Before any type of roadbed stabilization can be undertaken with confidence, surface drainage should be in good repair, so that water does not stand against the roadbed; the widths of cuts and fills should be adequate, and their slopes should be flat enough to be inherently stable against sliding or sloughing off. Longer than normal ties are helpful in some cases.

Pipe Drains

The use of pipe drains of various types has been common, and more or less successful. Unless there is free water present above a comparatively solid plane, and the drains are below the lowest water, such drains are not successful. In many instances unsuited to pipe installations, these installations have not only failed to stabilize the roadbed, but have failed to discharge water, and many such drains have heaved out during further development of the soft spot. Pipe drains may be installed without disturbing the ballast section, but generally this is not satisfactory because of the usual necessity or desirability of covering the pipe with pervious material to permit the water to collect and enter the pipe. The

most successful present use of pipe drains is for collecting and conducting to borrow pits the water that falls between parallel tracks, in which case they generally are not subject to so much movement and pressure from traffic as when installed beneath tracks.

French or rock drains are expensive and difficult to install and do not succeed unless there is free water present. They are subject to failure by being stopped up by material washed from the adjacent roadbed in the process of drainage, by subsidence and by backwater entering them.

Concrete slabs, whether directly carrying the rails, without ties and ballast, or sub-ballast slabs, have been comparatively successful so far as stability is concernd, but are expensive when installed in operated track, and ordinarily would not be considered for stabilization only. Wood sub-ballast mats fall in about the same class.

The replacement of the entire ballast section in operated track is usually impossible, and most attempts to stabilize by skeletonizing it and placing an impervious blanket over the entire roadbed have been expensive and only partially successful. Also, only partially successful have been walls built of impervious materials or rock placed in trenches outside the ends of the ties.

All of the above methods of stabilization are inherently rather costly and are also difficult to install under present heavy, fast traffic. They have been discussed only to present the subject of roadbed stabilization in a rather broad, but brief manner.

Several hundred miles of railway tracks have been stabilized by the driving of cull or second-hand ties, poles and old rails, with generally fair to good results. Some of this work has been done with off-track drivers. However, a larger part has been done with track-mounted drivers, some of which are so equipped that they can be set off the track quickly. Some times in work of this character it is necessary to use waling beams and to tie the tops of the poles together under the track. The driving of ties and poles does not dispose of the water, but does reinforce the roadbed. The cost of this work is generally lower than that of elaborate drainage systems, and is probably more generally reliable.

In all of the above methods a period of time is generally required before the disturbed roadbed and ballast section reach their maximum stability; the more they have been disturbed, the greater the period needed for them to become settled.

The widening of cuts and fills and the building of false berms or banquettes have done a great deal toward stabilizing certain sections of roadbed, and can be done usually without disturbing the roadbed or interfering with traffic. The grouting of the upper ballast without pressure, or the filling of the upper ballast with asphalt, may have some stabilizing effect, but neither of these methods would ordinarily be used over active water pockets.

Applying Grout by Pneumatic Pressure

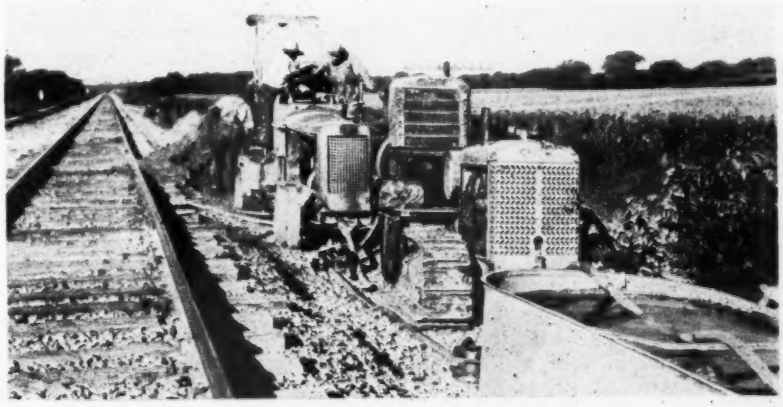
ROADMASTERS

Two Methods of Grouting

Within the last few years, the application of pressure grouting to the stabilization of railroad roadbeds has become quite popular and has generally been successful, saving, according to many reports, 70 per cent or more of the direct track labor by section forces, and being the lowest cost method known to date. This method does not interfere with traffic, is delayed less by traffic than any other method, and re-establishes stability of the roadbed in a very short time, with little or no seasoning period. Furthermore, it seldom requires slow orders for the protection of traffic or of the gangs doing the work.

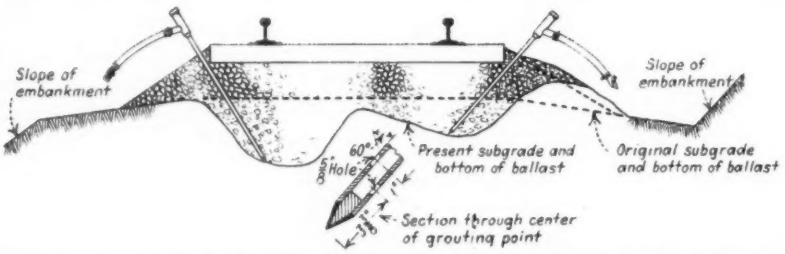
There are two widely divergent methods of roadbed grouting, (1) hydraulic pressure grouting, and (2) pneumatic pressure grouting. There are likewise two opposite schools of thought with respect to the composition of the grout mixture employed.

In the earliest track stabilization by pressure grouting, pneumatic pressures and rich mixtures or neat cement grouts were most common.



An Outfit for Applying Grout by Hydraulic Pressure

Today, there are, no doubt, more pneumatic grouting outfits in use than hydraulic outfits, but the greatest mileage of roadbed to date has been stabilized by lean mixtures injected by the hydraulic method. Both types of grouting and both types of



This Drawing Illustrates the Manner in Which Grout Is Applied to the Roadbed Through Grouting Points. Details of Points Also Shown

mixtures have been applied with successful results in all sorts of soils and climates, in regions of extreme drouth and extreme rainfall, in minimum cuts and fills, and in deep cuts and very high fills.

For a rather complete history of the development of the art of pressure grouting as applied to roadbeds, see "Concrete for Railways" Vol. 3, No. 4; Vol 4, No. 2; Vol. 5, No. 3; Vol. 6, No. 4; Vol. 7, No. 2; Vol. 8, No. 1; Vol. 8, No. 2. Also, *Railway Engineering and Maintenance*, November, 1944, and May, 1945; Railway Age, January 13, 1945; and Engineering News-Record, August 24, 1944.

During the four years, 1941-1944, one large railway has stabilized with pneumatic pressure and rich mixtures, nearly seven miles of track consisting of 197 comparatively short water pockets. This work, in both the United States and Canada, was done at an average cost of slightly more than $1.50 per track foot. The average length of water pocket was less than 200 track feet. Savings in track labor are said to have been very great, and no failures are reported. Several other railways are using the pneumatic pressure method, but in no case on so large a scale. These railways, most of which use rich mixtures or neat cement, also report successful stabilization.

200 Miles Grouted

The large Western railway which developed roadbed grouting with hydraulic pressure has stabilized approximately 200 track miles since 1942. Of this, a small mileage was short pockets, but by far the larger part was out-of-face stabilization of long stretches of soft track. Very satisfactory results have been obtained in this work, and no complete failures to stabilze have been recorded. Costs to date have averaged a little more than $0.65 per track foot. The savings in track maintenance have not been so great as in the case cited earlier, because it seems that short water pockets are sometimes much more extreme and require more labor per track foot before stabilization than do the long soft spots, which, in some cases, are continuous for miles. Several railways have adopted the hydraulic pressure grouting method and most of these roads use lean mixes.

Must Fill Voids

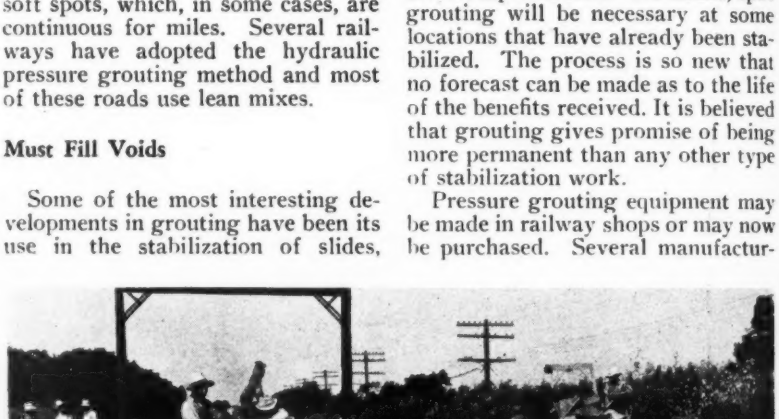
Some of the most interesting developments in grouting have been its use in the stabilization of slides, mainly in embankments and in sidehill sections of roadbed, and the stabilization of tracks in tunnels. All of these cases have been successful, although the cost of the work has been much higher than those mentioned previously. In the case of severe slides, where the natural ground beneath the roadbed is unstable, or where there has been a good deal of movement in the fill, the roadbed material usually contains a large percentage of voids and a large volume of material is required to fill the voids and stabilize the roadbed.

No matter what method of placing the grout is used, fine sand and cement are necessary in most cases. Fine sands can be pumped with less cement than can coarser sands. In lean mixtures, the main function of the cement is as a lubricant, although it generally adds a permanent "set" to the mixture. The addition of emulsified asphalt in small quantities improves the ease of pumping and adds to the density and waterproof character of the grout.

Second Injection

No matter what mixture is used or how it is placed, the object of grouting is to expell water from the roadbed and fill all voids. It is not the purpose to form a concrete slab or roadbed. In some cases it is necessary to inject grout more than once before all of the voids are filled, and at times improved results are obtained by a second injection of grout after a lapse of time. No doubt, spot grouting will be necessary at some locations that have already been stabilized. The process is so new that no forecast can be made as to the life of the benefits received. It is believed that grouting gives promise of being more permanent than any other type of stabilization work.

Pressure grouting equipment may be made in railway shops or may now be purchased. Several manufacturers are either building or preparing to build and market suitable equipment. The main items of equipment needed for efficient work are mixers; hydraulic or pneumatic placing equipment; air compressors; paving breakers; heavy-duty hose; bull points or spuds; and pipes or so-called "mud points," with quick-acting couplings; together with water storage tanks or barrels and water-handling facilities.



In this View the Men Between the Tracks Are Driving a Bull Point

The details of grouting work are very simple, and no extensive investigation of the roadbed is necessary. When neat cement is used, little can be done to increase the pumpability of the grout unless asphalt or some

similar material is added. When using mixtures containing sand, and the voids are too small to be readily penetrated, the mixtures must be enriched. When driving the pipes or tubes, longer injection points should always have pressure in them to prevent undue stoppages. Grout should always be injected to the point where no more will be retained, or until the track is raised objectionably.

Water is used only as a vehicle, and the minimum quantity necessary to insure free flow of the grout should be used. The water ratio should be changed whenever necessary to meet these requirements.

Even with the precautions mentioned above, full penetration of all voids is seldom obtained, at least with a reasonable expenditure of time. When there is any doubt that satisfactory penetration has been attained, longer injection points should be inserted and further attempts made to inject grout at lower levels.

When planning grouting programs, it has been found that most organizations do not realize the possibilities of the process, and many locations that can be grouted successfully are overlooked, necessitating a second trip over the territory with the equipment. Most track that requires a considerable excess of labor to maintain it is likely to justify observation to determine whether it can be improved by grouting. A study of time books and of slow orders will often reveal locations that should be grouted, when the reason for excess maintenance expense and slow orders has not been fully recognized. The simplest test, as well as the cheapest, is to attempt to inject grout in such spots.

It is not inferred that pressure grouting of the roadbed is a "cure-all." It is contended, however, that it has a wide range of possibilities; that it has resulted in great improvements in many miles of track under heavy, fast traffic; and that it has been the means of removing many slow orders and of relieving a great deal of man-power formerly necessary to maintain soft track.

An interesting example of the effective use of grouting to overcome slide conditions was completed recently near Dallas, Tex., in a fill 16 to 18 ft. high. Here, where the slide extended over a distance of 250 ft., the track was on a 2-deg. 4-min. curve, on a 1.61 per cent grade, built in 1872 of plastic material. The locality is generally wet.

The track at this point was originally ballasted with cinders; subsequently with three or four kinds of gravel; and in 1941 with crushed rock. Under the pounding of traffic, the ballast had penetrated the entire depth of the fill and had pushed out to one side under the toe of the fill for a considerable distance.

Earlier attempts to stabilize the fill had included the installation of French drains; the driving of 25-ft. pine poles in the low side shoulder; flattening the slopes of the embankment to 4 to 1; and, in 1943, the driving of 30-ft. 8-in. by 16-in. ridge stringers outside the line of previously driven poles. In spite of these measures, slow orders, from 15 m.p.h. upward, had been necessary for many years, and it was not uncommon to lose from one to two inches of surface over night. In 1943, to permit a speed limit of 15 m.p.h., section labor costs had amounted to more than 50 cents per track foot per week.

Between December 1 and 22, 1944, this slide section of track was grouted with more than 6,000 cu. ft. of grout. At the same time, a short section of track in a cut upgrade from the slide was grouted to prevent water from flowing down into the slide area. Following the grouting, the track was lined and surfaced, and when it was observed in February, 1945, that the track continued to hold up successfully, superelevation in the track was increased to permit high speeds.

Since the grouting was completed, to June 28, 1945, only 28 hours of section labor were expended on the track in this slide area, and by June 10, 1945, the entire cost of the grouting, $3,774.00, had been offset by the saving realized in direct track labor.

While your committee does not have definite figures relative to the stabilization of other slides by pressure grouting, it is known that all slides grouted to date have shown a marked degree of stabilization, with resulting large savings in track maintenance and increases in permissible speeds.

The Stakes in this View Are Set in Holes Driven by Bull Points but Not Yet Grouted

ROADMASTERS

Committee Personnel

J. R. Rushmer (chairman), roadway engineer, A.T.&S.F., Amarillo, Tex.; W. S. Broome (vice-chairman), engr. m.w., Colo. & Sou., Denver, Colo.; A. B. Chaney (vice-chairman), dist. engr., M.P., Little Rock, Ark.; E. J. Brown, engr. of trk., C.B.&Q., Chicago; F. L. Etchison, engr. m.w., A.C.L., Savannah, Ga.; R. L. Fox, rdm., Sou., Alexandria, Va.; R. L. Griffin, rdm., S.A.L., Monroe, N.C.; W. H. Hillis, oper. off., C.R.I.&P., Chicago; J. C. Jacobs, div. engr., I.C., Water Valley, Miss.; Houston Jarrell, rdm., N.O.&L.C. (M.P.), New Orleans, La.; H. W. Kellogg, div. engr., P.M., Saginaw, Mich.; G. S. King, supv. of trk., Sou., Gainesville, Ga.; W. B. Lee, div. engr., W.M., Cumberland, Md.; R. L. Longshore, ch. engr., Sacramento Northern, Sacramento, Cal.; G. B. McClellen, gen. rdm., T&P, Ft. Worth, Tex.; Paul F. Muller, rdm., C.&W.I., Chicago; M. W. Rector, v.p. & g.m., W. H. Nichols Co., Inc., Dallas, Tex.; S. B. Ringgold, ch. engr., Miss. Cent., Hattiesburg, Miss.; A. W. Schroeder, supvr. extra gangs, C.B.&Q., Chicago; R. S. Vermillion, rdm., M.P., Sparta, Ill.; Charles Weiss, supvr., Penna., Valparaiso, Ind.; A. W. Werner, rdm., S.P., Lake Charles, La. and J. G. West, div. engr., A.T.&S.F., Slaton, Tex.

Discussion

This report was read by E. J. Brown (C. B. & Q.) in the absence of J. R. Rushmer (A. T. & S. F.), chairman of the committee. The discussion was opened by N. D. Howard *(Ry. Engr. & Maint.)*, who pointed out that there are two general types of grout used for roadbed work—one containing asphalt and little cement and the other no asphalt and considerable cement—and raised the question as to which of these mixtures gives the best results. Mr. Brown expressed the opinion that this is still a debatable issue. When asphalt was first used in mixes for roadbed grouting, the pur-

General View of a Main-Line Grouting Operation

pose, he said, was to supplement the water as a conveyor for the sand in the mix, but from subsequent experience with such mixes it was found that when asphalt is used a smaller amount of cement is required.

Commenting on this same phase of the subject, President Banion pointed out that the purpose in adding asphalt is to facilitate the flow of sand into the voids. His experience is that rich cement mixes for roadbed grouting are undesirable because the solid mass formed might eventually break up and "start moving," thereby defeating the purpose of grouting. When roadbed grouting was first tried out on his road Mr. Banion said that engine sand was used in the grout, but that the results were not satisfactory. Somewhat by accident a material known as blow sand, or "good potato ground," was then used and found highly effective.

F. E. Schaumburg (Caterpillar Tractor Co.) described an instance in which it was found impossible to inject grout into the roadbed. In this case the track was ballasted with fine chatts, with water being encountered 12 to 14 in. below the bottom of the ties in a roadbed containing quicksand and clay. Mr. Banion stated that he had not encountered any situation of this sort but that he had had experience with situations in which difficulty was experienced in grouting shallow water pockets, there being "nothing to hold the grout down." In such cases, he said, it is sometimes helpful to put the grouting points in at a more shallow angle than is customary, and to use sacks around them to prevent leakage of the grout.

Yard Maintenance Under Extraordinary Traffic

Committee Report

Henry C. Koch
Chairman

EACH day more than a million cars, loads and empties, are handled in several thousand yards and, by various switching operations, are sorted or classified into trains for many destinations. Almost all facilities are being used to and beyond their designed capacity in handling our war-time traffic. In normal times it requires considerable planning and close cooperation with the operating department to maintain these yards efficiently with minimum delays to switching. Insufficient and less efficient labor during the last few years has increased maintenance problems to such an extent that the forces available are used only for the more essential maintenance work. This is especially true in terminals where a large volume of traffic is handled through the yards. Present conditions are far from ideal also because of the frequent necessity of doubling up many sections to bring together enough men to handle the work properly and safely maintaining yards during this period of extraordinary traffic could be handled more efficiently and with less effort if more and a better quality of labor was available.

A section or yard foreman should be assigned to a yard or part of a large yard. An efficient man soon becomes familiar with local conditions and acquires experience with problems of the operating forces so that he can perform his work with the least amount of delays. There should be 12 to 20 men in the gang and, where gangs are smaller, which is often the case, the doubling of sections is necessary for some work. When this is done, the local foreman or a general foreman should be in charge. Extra gangs assigned to work in yards produce best results if they work separately, but there are occasions when it is necessary that they be doubled with the yard forces.

Tools and Machines

Yard gangs should be equipped with the usual tools furnished track maintenance gangs. In the larger yards, power tools, such as tie tampers, rail drills and bolting machines increase efficiency and can be kept busy most of the time if the necessary forces are available.

The tool house should have ample room for the storage of those tools, equipment and materials requiring cover. Space for the men to keep their clothes and benches for them to sit on when eating in the tool house are also important. A location near a road facilitates the transfer of men, equipment and material by truck. Such location should also be adjacent to a track that can be used for unloading and loading cars at material piles and scrap bins, without serious interference to yard switching. An improperly located yard tool house causes

delays that reflect on the efficiency of the work in the yard.

During the present period of extraordinary traffic it is extremely important for the maintenance forces to cooperate fully with the operating department. Taking tracks out of service for short periods and for minor lead repairs should be handled by the foremen with local yardmasters. They can usually come to an agreement as to when work can best be done, having in mind safety of the track and traffic conditions. When conflicting opinions delay necessary work, it becomes the roadmaster's problem to handle the matter with the local trainmaster or superintendent, and it is up to these men, jointly, to work out a schedule so the work can be performed with the least changes in and delays to normal operations.

Repairs to Lead Switches

Work on leads, especially out-of-face renewals or surfacing of a number of switches, requires very careful planning. In such cases, considerable cutting and drilling can be done in advance, and, if there is room to store materials safely along the leads, this preliminary work should be done after the rail has been distributed opposite the switches in which it will be used. Where lack of room prohibits the safe distribution of materials in advance, and it is necessary to store it some distance from the job, cut rails should be plainly marked to avoid mistakes and delays in picking them out at the time the work is performed.

Jobs of this kind should be started at the lower or lead end of a ladder, and as each switch is finished it should be restored to service. If men are available, a large number can be used on a long ladder by assigning each gang to a certain part of the work. It may be necessary to make temporary closures or run-offs to permit the movement of trains, but if a schedule can be arranged so that the first trains out will use the first switches completed, these interruptions can be held to a minimum.

Use of Power Tools

The efficient use of power tools in yards depends on the size of the job. Cutting and welding outfits, bolting machines, small tamping outfits and cranes for handling heavy materials are found to be economical and will shorten the time tracks are out of service. Extreme care must be taken when using this equipment on or adjacent to live tracks.

Protecting switch points with bent or welded housings, or applying manufactured types of point protectors, and equipping switches with automatic stands that allow the points to spring over when switches are run through, decrease accidents and consequently reduce delays from this cause. Repairing worn switch points and frogs by welding without removing them from the track conserves labor and material and also eliminates the delays that would otherwise be caused by renewals.

In surfacing ladders, especially those with small numbered frogs, the straight side should be elevated slightly and this elevation should be run out on the tangent of each track.

Work on Yard Tracks

In most yards tracks can be taken out of service for short periods only, with the result that the handling of material in and out consumes considerable time. When rail is renewed out-of-face on long tracks, material can be laid out neatly along the tracks so that it will not interfere with employees walking through the yard. Some material, such as tie plates, can be stored between the rails. Such distributions should not be made more than a day or two prior to starting the job and must be covered by bulletin. The distribution of materials is faster by work train than by other means, but traffic demands and shortages of power and crews have resulted in the elimination of this service to such an extent that other methods are now being used. A crane spotted alongside material cars or stock piles can readily load push cars or motor car trailers. Rail unloaded for future use should be stored on skids as high as push cars or trailers to facilitate its subsequent loading on such equipment by a few men.

Shortly after the necessary material is distributed, the rail should be laid and arrangements should be made to pick up the salvage. Here again the use of a work train may be more efficient on long tracks, but if such a train is not obtainable, trucking out on push cars will have to be resorted to. When this is necessary, and the released rail is scrap—especially where an insufficient number of men are available—it may be best to cut the rail into shorter lengths to permit the men to load it safely. Cutting the rails for this purpose can be done readily by nicking its base with a torch and then striking it with a sledge.

Even with gangs of moderate size the laying of rail and the removal of the salvage material should be done within a few days. If tracks are required after working hours, safe closures must be made and any surplus salvage that cannot be stored along track safely should be trucked out. When all traffic is in one direction, yard tracks should be anchored sufficiently to eliminate slewing ties and buckled rail.

Ballast unloaded for out-of-face surfacing should be leveled and, if the lift requires considerable ballast it should be distributed in two runs, the second run to be made after the raise and this ballast to be used for inside tamping and dressing. When this work is being performed, temporary run-offs should be made so the tracks can be put back in service after working hours.

Hump Yards

Maintaining retarders, switches, crossings and tracks over which cars are humped calls for considerable advance planning and close co-operation with the operating department. Most hump yards are so designed that only

Proper Attention to Switches Promotes Better Co-Operation With the Operating Department

ROADMASTERS

a part of them need be taken out of service to carry out localized track work. However, frequently the renewal of rail, switch material and crossings, as well as surfacing, requires the cessation of operations over all or part of the hump end of these yards for varying periods. Such work is generally performed between trains being humped, or while a portion of the yard is out of service for other reasons, such as the signal department forces making repairs to retarders, or while crews are in to dinner. Where several engines are used in humping operations very little time is available between trains for maintenance work of any great extent.

The hump is the "heart" of a hump yard and stopping its use affects all other parts of the yard. Therefore, every opportunity should be taken to utilize for track work all time that will not interfere with efficient operation of the hump.

Miscellaneous Yards

The tracks at passenger terminals, engine terminals, coach yards, freight houses, team yards and other auxiliary yards require the same careful planning for their maintenance. In some cases, due to set schedules, work can be done on these tracks without interfering with traffic. Considerable work is done on some of these tracks on Sundays and holidays when the facilities involved are not operated. Night working schedules should be avoided as much as possible.

The cleaning of tracks in coach yards and engine yards and those serving freight houses should be assigned to the department using the facility. Where this is the practice there is a tendency to be more careful about such items as overloading engine tenders at coal chutes and scattering rubbish from cars.

Cleaning—Weed Control

Various methods are used to clean tracks and leads, depending upon conditions and the equipment available. Considerable hand labor is necessary to load cleanings in carrying boxes, push cars and regular standard-gage cars, or to shovel it into piles so that a locomotive crane can load it into cars. The use of a crane is faster if the job is big enough, but usually requires taking three tracks out of service to operate the crane safely.

Chemicals, weed burners and a number of other methods are used to destroy and retard the growth of weeds with varying results. Where heavy equipment is used, the work must be carefully programmed in advance as yard tracks must be cleared for the movement of this equipment. Fewer weeds mean better working conditions and less fire hazard.

Care of Switches

The care of oil lamps should be assigned to one man who will become familiar with the territory. Usually, this man also oils switches and makes minor switch repairs. If the cleaning and oiling of switches is neglected they are hard to throw, resulting in complaints and possible injury to the men using them. The switches of some busy ladders require almost daily attention due to the constant use of sand by switch engines. The present labor shortage may make it impossible to keep such switches in the best condition at all times, but those foremen who do keep their switches in good operating condition find that it results in better and more cordial co-operation with the operating department forces. Electric switch lights are serviced by personnel of the signal department.

Periodic switch inspections are required on most roads. Some require signed reports by the foremen or roadmaster. Whatever method is used, the importance of regular inspections cannot be stressed too much, as experience shows the majority of yard accidents occur at switches.

Winter Work

While keeping yard facilities functioning properly with reduced forces is a big job in good weather, it calls for a great deal of extra effort during snow storms, and requires the close co-operation of all departments during these emergencies. Before cold weather sets in, available men should be assigned to vulnerable locations, instructions should be issued, and snow-handling tools, equipment and supplies should be delivered to section tool houses and other places where they will be readily obtainable when needed. Leads should be cleaned and any faulty drainage conditions about them or elsewhere in the yard should be improved before the ground freezes. While each storm brings its own problems which must be worked out as they develop, advance planning is extremely important to keep the switches in a busy yard in good operating condition. During blizzards, when the available forces are inadequate to keep all switches open, a foreman must keep in close touch with operations so that the most important switches will be cleaned first.

Power Tools May Be Required to Break Up Accumulations of Ice and Dirt in Yards

Snow Melters

Snow melters or burners of various makes and designs are used in busy locations. They usually require some extra maintenance and care, but they pay dividends in a bad storm. Snow blowers can be used effectively if engine power is available and the men follow up behind them and remove wet snow on switch plates or apply salt to prevent freezing. During extremely heavy snows several loaded coal cars shoved by an engine can be used to "break" the tracks, and on occasions it may be necessary to remove snow in busy yards.

Sleet and ice along switching leads create unsafe conditions for trainmen. Salt, either alone or mixed with cinders, is used to correct this unsafe condition. In cases when extremely cold weather extends over a long period, it may be necessary to use power tools to break up the accumulation of ice and dirt, after which it can be trucked out or loaded into cars.

When weather is favorable, certain maintenance work can be programmed; in fact, almost all kinds of yard work is being performed in winter, except surfacing and putting in ties. Changing rail may require shimming, but shims are easily removed when surfacing track in warm weather. Enough work should be scheduled to keep the regular gang busy all winter.

This permits the foreman to have a steady gang, with men available for use in snow storms and other emergencies. It also gives him the necessary men for putting in ties and for surfacing just as soon as frost disappears from the track.

Conclusion

Many yards in their present design and arrangement are not conducive to the most economical operation and maintenance. This situation has resulted in many instances in the piecemeal expansion of a small facility that could have been planned better if future needs had been known when the yard was originally built. An inadequate area available for yard construction, poor locations requiring excessive curvature, poor drainage and similar factors create difficult operating and maintenance problems. In other cases, maintenance in yards has been neglected to the point where accidents are frequent. These cause considerable lost time to switching. There is no logic in maintaining fast schedules on main lines and then delaying cars in yards or terminals for any reason.

While it is important to keep yards clean, traffic conditions do not always permit scrap, coal, etc., to be trucked out as it falls from cars. In some cases this material is placed between rails temporarily, but it would be much better if wide centers were available every six or eight tracks to permit the temporary storing of such materials. Furthermore, such wide centers in busy yards would provide desirable space for the storage of necessary track materials and for the operation or clearing of off-track equipment. During the winter they would provide room for snow in heavy storms.

Every effort should be made to relay light rail with heavier sections; to re-design leads for No. 10 or No. 11 switches; to widen track centers and improve drainage; and to change layouts, where necessary, to eliminate congestion or bottlenecks. Rearranging and modernizing existing facilities will result in faster and safer operation and maintenance. Considerable work can be performed in many yards along the lines suggested to improve operations, to lighten the work of the maintenance forces and to create safer conditions. Plans should be made now for such work so that it can be started when adequate forces are available.

It is not the purpose of this report to criticize or recommend changes in design, but we are of the opinion that many worth-while improvements can be made in many yards, which, if undertaken, will put the railroads in a better position to compete with other forms of transportation in the post-war period.

Committee Personnel

Henry C. Koch (chairman), rdm., Belt Ry. of Chicago, Chicago; P. L. Koehler (vice-chairman), trmast., C. & O., St. Albans, W. Va.; V. E. Pearson (vice-chairman), rdm., S.P., Sacramento, Cal.; N. F. Alberts, gen. fore., C.M.St.P. & P., Chicago; S. J. Caesar, trk. supvr., Chi. W. Pull. & Sou., Chicago; E. E. Crowley, rdm., D. & H., Albany, N.Y.; A. B. Hillman, engr. m. of w., C. & W.I.-Belt Ry. of Chicago, Chicago; V. V. Holmberg, supvr. b.&b., C. & W.I., Chicago; R. S. Marshall, dist. rdm., G.N., Superior, Wis.; F. H. Masters, ch. engr., E.J. & E., Joliet, Ill.; Lee Spencer, supvr. trk., L.I. (retired), Phoenix, Arizona; H. D. Van Vranken, asst. div. engr., S.A.L., Jacksonville, Fla.

Discussion

F. G. Campbell (E. J. & E.) inquired whether any one had experienced any trouble by reason of yard crews running through automatic safety switches deliberately. Several members replied in the affirmative and stated that these switches have been damaged, severely in a number of cases, by being run through continually.

H. R. Clarke (C. B. & Q.) questioned the desirability of the recommendation that all switches and frogs be repaired by welding in the track. He contended that, while this can be done satisfactorily in some cases, there are many instances where it is undesirable from a physical standpoint as well as from that of interference with switching. President Banion stated that he has sometimes replaced defective points so that the repairs can be made to better advantage out of the track.

ROADMASTERS

Turnouts for Ladders

J. E. Fanning (I. C.) questioned that part of the report relating to No. 10 and No. 11 turnouts for ladder tracks and inquired whether the committee had record of any such leads in actual service. Chairman Koch replied that the committee had no such record and that he knew of none personally, but that the discussion was included in the report primarily because many of the replies to a questionnaire upon which the report was based recommended such ladders.

Calling attention to that part of the report dealing with the superelevation of turnouts on ladders, Mr. Mottier inquired whether this is a general practice or a restricted one. Chairman Koch replied that it is being done by a number of roads, but he did not know how widely the practice is being followed. Mr. Campbell expressed doubt about the desirability of such superelevation because of the probable effect on track maintenance and on the life of materials in track that is out of level. He also raised the question of the cost of distributing materials in yards by means of work trains, because of the inherent high cost of work-train service and the probabilities of delays when working in a busy yard.

Careful Preparations Are Required to Keep Yards Functioning Under Winter Conditions

The discussion then turned to the wide centers between tracks which were recommended by the committee, and Mr. Koch said that he had information that some yards have been laid out in this manner.

Mr. Clarke then emphasized the importance of the observation made by the committee that it seemed useless to move trains at high speed over the road if the time thus gained is to be lost while passing through terminals.

The Track Supply Association

THIS year, for the third successive time since 1942, restrictions on travel and on attendance at meetings, which permitted only one-day annual meeting of the Roadmasters' and Maintenance of Way Association, made it impractical for the Track Supply Association to present its annual exhibit. However, members of both the Roadmasters' Association and the Track Supply group are looking forward with keen anticipation to the possibility that next year the manufacturers will again be able to supplement the convention with an exhibit of their products—an exhibit that is expected to be doubly interesting and instructive because of the many advances in materials and equipment design that have taken place since the last exhibit was held.

From the earliest years of the Roadmasters' Association, manufacturers of materials and supplies and, later, of power equipment, for railway maintenance, have been of real service to those members who have attended its annual meetings. In more recent years, up to the outbreak of the war, this service has been greatly enhanced by the splendid exhibits that have been presented by these manufacturers through the Track Supply Association. The members of the Roadmasters' Association have profited in large measure through the opportunity thus afforded them to study the actual machines, materials and appliances that were available to them.

For more than three decades, since the Track Supply Association was organized, to supplant an older and less effective organization, the mutual respect and co-operation between the roadmasters and the manufacturers have been of definite benefit to both. As an indication of the value that the roadmasters place on the exhibit of the Track Supply Association, they have always, in the selection of the places for their meetings, included the requirement that accommodations for the exhibit must be available.

The officers of the Track Supply Association who have carried on its activities since the last exhibit three years ago, and who, with one exception, have been retained in office for the coming year, are: President, H. C. Hickey, The Rail Joint Company, Inc., Chicago; first vice-president, H. M. McFarlane, O. F. Jordan Co., East Chicago, Ind.; second vice-president, Thomas D. Crowley, Thomas D. Crowley & Co., Chicago; secretary-treasurer, Lewis Thomas, Q. & C. Company, Chicago; directors, Edward Wray, Railway Purchases & Stores, Chicago; L. I. Martin, Morden Frog & Crossing Works, Chicago; H. A. Morrison, *Railway Engineering and Maintenance*, Chicago; C. B. Armstrong, Air Reduction Sales Company, Chicago; C. O. Jenista, Barco Manufacturing Company, Chicago; J. B. Templeton, Templeton, Kenly & Company, Chicago; and R. M. Blackburn, The Buda Company, Chicago. The only change in the roster of officers since last year was the election of Mr. Wray to fill the unexpired term of F. A. McGonigle, resigned.

A Message From the President and Secretary

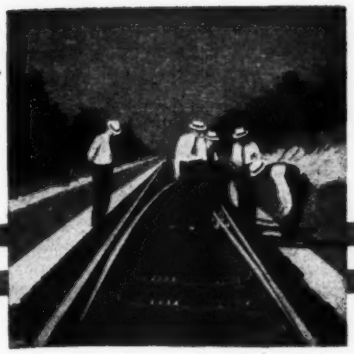
The last previous exhibition of the Track Supply Association was held in conjunction with the annual meeting of the Roadmasters' and Maintenance of Way Association in 1942. Since the members of our association were unable again this year to display their products in a regular annual exhibition, we welcome this opportunity to join with *Railway Engineering and Maintenance* in its Convention-in-Print issue.

The railways have done a splendid job of moving both material and personnel for the armed forces during the last four years of conflict. Under this, the greatest traffic load in history, the maintenance of way departments of the various roads have played an important part in keeping the railways functioning so effectively, particularly in view of the fact that they were constantly contending with a severe shortage of man-power and with reduced allocations of track materials. Now that the war is over and we can return to peace-time pursuits, a huge task remains to make good the wear and tear of recent years which, by force of circumstances, it became necessary to defer until a more favorable time.

Our member companies are delighted to have been of assistance to maintenance-of-way officers in the solving of the problems that confronted them during the war period, by providing them, so far as it lay in their power, with improved products and power equipment. Since our association has been able to maintain its full membership throughout these difficult years, it is now ready to co-operate fully with the Roadmasters' Association in the work that must be done in the years immediately ahead.

We value greatly the close association and the spirit of mutual respect that exist between the members of our two associations, and look forward with pleasant anticipation toward the opportunity we will have in the coming year of supplementing the annual meeting of the Roadmasters' and Maintenance of Way Association with a worth-while exhibition.

The 19 Member Agencies of the National War Fund Still Have a Big Job to Do, Which Has Not Been Altered by V-J Day



What's the ANSWER?

Applying Anti-Splitting Irons

Should anti-splitting irons be applied to all ties? Why? If not, to what ties? When should they be applied? Why? How many? What type of iron is most satisfactory? Who should apply them?

Favors S and Z Irons

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Anti-splitting irons are so necessary, not only to insure the highest standard of track, but to conserve our dwindling timber resources, that any one who is responsible for the care of the ties prior to their insertion in the track fails in his duty if he does not apply the irons when the need for them is indicated. In general, only hardwoods split sufficiently to damage the tie and shorten its service life, but if ties of any of the softwoods show a tendency to split, they should also have irons applied.

Any type of iron is acceptable, provided it prevents the splitting of the tie, but my observation leads me to believe that the S and Z-irons do the best job. However, there are other designs that seem to be satisfactory and some maintenance officers prefer them. Ties that tend to split while seasoning always continue to do so after they are installed in the track, unless they are prevented from doing so through the use of anti-splitting devices, of which the better designs of anti-splitting irons provide the best protection.

It seems to me that we have far more trouble now as a result of tie splitting than we had a relatively few years ago when all of our ties were hardwoods. Possibly our trouble can be traced in part to lower quality in the timber, yet I believe that it also comes in part from a poorer grade of track labor. Today, also, ties are prebored, and we drive the spikes in the prebored holes regardless of the location of incipient splits. The trackman of the past knew where to set the spike to avoid splitting the ties and, to this extent, conserved tie life. Furthermore, the ties of today are performing far more severe service, based on ton-miles of traffic passing over them and the intensity of wheel loads, than all but a few of the ties of a decade or two ago.

To Hardwood Ties

By Chief Tie Inspector

Hardwoods all show a tendency to split as the wood seasons. However, different species vary between wide limits in the amount of splitting that occurs, and there is a further differentiation between woods of the same species that are grown on hills or in low lands and swamps. Our experience has been that less than 30 per cent of our hardwood ties develop damaging splits during the seasoning period, but that a material saving can be brought about by the use of anti-splitting irons. Tests which have been conducted to determine the advantages and the methods of application have led to the following conclusions:

(1) Anti-splitting irons should be applied to hardwood ties.

(2) Two irons should be applied at the end of a tie.

(3) Ties should be ironed by the selective method, that is, the stock of ties on yard should be examined at regular intervals, and at each examination only those ties that display indications of developing damaging splits should have irons applied.

(4) The irons should be applied

Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered in December

1. *To what extent does traffic shorten the life of ties? Does the character of the traffic or the speed of trains make any difference? In what ways?*

2. *To what extent can plastics be used in the construction and modernization of railway buildings? For what purposes? What are the advantages?*

3. *What injuries to the base of a rail require its replacement? Why?*

4. *Should open-deck bridges have inside guard rails? Outside guard rails? Why? How should they be applied? What is the best method of insuring the correct spacing of the ties?*

5. *What effect does curve reduction have on the life of track materials? On routine track maintenance? Why? What other considerations are involved?*

6. *What type of pump is most satisfactory for pumping from wells? Why? Does the depth of the well or the character of the water make any difference? The volume to be pumped?*

7. *What provision, other than the use of discarded box cars, can be made for housing section laborers? Extra gangs? Large permanent gangs? What are the advantages? The disadvantages? Can the same provision be made for bridge and building gangs? Why?*

8. *What is the most satisfactory form of support for turntable circle rails? How should they be installed? What are the advantages?*

reasonably soon after the ties are cut, which ordinarily is when they are delivered to the seasoning yard, and during the seasoning period.

(5) Most ties are cut from small trees and have the pith reasonably close to the center of the ends of the ties. Splits start from the surface of the tie and follow radial lines toward the pith, for which reason the anti-splitting irons should be placed near the edges of the tie, so as to stop the split before it has had an opportunity to damage the tie seriously.

(6) Men should be selected and given special training in the correct method of applying anti-splitting irons, after which they should be assigned regularly to this work at the various seasoning yards.

Our studies and our experience both indicate that if the foregoing plan of applying the irons to the ties is followed, the service life of the ties will be greatly improved and lengthened, and that the highest return on the investment in anti-splitting irons will be obtained.

Troubles With Gumbo

What can be done to improve track maintenance during dry weather on embankments built of gumbo? In wet weather?

Gumbo is Unstable

By C. Halverson
Division Roadmaster, Great Northern, Willmar, Minn.

Gumbo embankments are unstable, and when track is constructed on them, there are varied problems that confront the maintenance forces. Because of its fine-soil properties gumbo has high capillarity, which accounts for capillary moisture in the subgrade soil, which tends to lubricate the soil particles, leaving a plastic substance that will give under traffic and cause settlement of the track. This results in irregularities in cross level and alinement, which require frequent attention and, at times, conditions become so bad that it is necessary to restrict the speed of trains.

Because of the unusual condition of the soil and the pressure of capillary moisture, irregularities in track are experienced in dry as well as wet weather. Settlement of the track occurs when the ballast is being driven deeply into the subsoil by the pounding of trains and, when there are extreme conditions, large bulges can be observed in the face of the embankment where ballast pockets are being forced out. Adequate drainage that effects quick disposal of the surface water will give relief.

One plan is to fill the old borrow pits, employing off-track tractors and bulldozers, bringing in dirt from the right of way to strengthen the embankment. A slope should then be provided that will permit quick disposal of the surface water to a new ditch that should be constructed approximately 35 to 40 ft. from the center line of the track.

Another plan is to doze the shoulder of the roadbed with a spreader to a point 8 to 12 in. below the bottoms of the ties, wasting the material on the slope, and to backfill with impervious material that will keep water out of the subgrade. This material should be compacted to provide ample side support, a factor of vital importance for gumbo-bottom track. This method also opens and drains any water pockets that may have formed at the ends of the ties.

During dry weather, because the gumbo shrinks as the water leaves it, numerous small fissures can be observed in the embankment, which invite the infiltration of surface water into the subgrade. If a covering of impervious material is spread over the gumbo embankment and the slopes are seeded with a good quality of grass, surface water will be prevented from entering into the subgrade. The track should then be given an out-of-face lift of 3 to 4 in. on clean sound ballast. The cribs should be filled to the tops of the tie at the center of the track and sloped toward the ends of the ties to allow the water to drain away quickly. A substantial saving in maintenance will result from this work and the riding qualities of the track will be greatly improved.

A Troublesome Problem

By F. H. McKenney
District Engineer Maintenance of Way, Chicago, Burlington & Quincy, Omaha, Neb.

The maintenance of gumbo embankments has always been a troublesome problem in that it is equally difficult in both wet and dry weather. In dry weather cracks open up in the embankment, allowing the ballast to drop into them and thus cause rough track, while in wet weather the gumbo may become plastic or even semi-fluid and push out on the ends of the ties, causing the rail to settle out of level.

Many remedies have been tried; one of the oldest is to place rock-filled drains, sloped from the center of the track to the outside of the embankment. The use of drain tile and corrugated pipe for draining these embankments is common. Another method is to drive poles, 8 to 10 ft. long and 6 to 10 in. in diameter, not more than 6 to 8 in. from the ends of each tie to bring the tops of the poles just below the bottoms of the ties.

If the poles are driven too far outside the ends of the ties, the soft gumbo may push up and out between the ends of the ties and the poles. This method has been quite successful in many cases, especially when the poles pierce through the bottom of the water pocket and permit it to drain to a lower porous stratum. Furthermore, the poles seem to stiffen the embankment just enough to prevent the movement of the material in the embankment. There are contractors who have special equipment from driving poles on both sides of the track simultaneously, and which can be set off in two minutes to clear trains. We have had some excellent results from driving poles in the manner described, but the results are not always 100 per cent satisfactory.

In some cases, sections of the track have been removed and soft gumbo pockets have been dug out and replaced with good material. While this is expensive it is generally effective for soft spots of small extent.

The newest method is that of forcing concrete grout into the gumbo pockets, below the rail and 3 to 5 ft. below the tops of the ties. This may be done by air pressure or by the use of a mud pump. Recent articles describing roadbed grouting have been published. We have tried two experimental sections of grouting gumbo soft spots, both of which show indication of giving excellent results. One has now been in for one and one-half years and the second for about a year. How long it will remain effective remains to be seen.

In dry weather, it is essential that all ground cracks be kept filled to retard drying and shrinkage and to prevent water from entering these cracks when it rains, thus causing slides and additional soft track.

These are some of the common methods used to maintain gumbo embankments. In grade raises or when constructing new embankments, every effort should be made to avoid the use of unstable material, even though this requires that satisfactory material must be hauled from a distance.

Sound Safety Practices

Who should be held responsible for maintaining sound safety practices among the bridge and building forces? Why? What measures have been found particularly effective?

Men Do Not Think

By Engineer of Bridges

The division master carpenter or, as most roads designate him, supervisor, should be held primarily responsible for sound safety practices among the bridge and building forces. He, of all officers, is most often with the gangs and their foremen. He must be familiar with safety rules and the reasons therefor. He attends all division staff and safety meetings and is best fitted in all ways to transmit and explain the practical application of rules to foremen and men. Usually he is a man who has had experience as a foreman, and often in lower positions, and has the confidence of all of the men that combine to make up his forces. The majority of safety rules now in effect are the result of unsafe practices, with which most master carpenters were familiar before these rules were promulgated.

Most accidents are the result of some one not *thinking*, of lack of observance of a clear-cut rule, or of lack of knowledge of the probable result of an action. A prolific source of accidents is the failure of scaffolds, both fixed and swinging. Most bridgemen are experts at tying knots, but occasionally even an experienced man will tie a "granny" instead of a square knot. To reduce such hazards, short schools of instruction are necessary. Each time a master carpenter visits a gang he should discuss safe practices, not contenting himself with merely saying "work safely" to the men, but to point out to both foremen and men potential hazards of common actions.

Supervisor is the Man

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

The master carpenter or supervisor is responsible for maintaining safe practices among the forces under his direction. Supervisory officers know, or should know, the capabilities and characteristics of their foremen and men and assign them to the various projects that must be carried on. Because of their age or physical limitations, some men may be suited to shop jobs but would be a hazard to themselves and to others if put to work on a steel bridge or a high trestle. It is the supervisor's responsibility, therefore, to see that both the men as individuals and the gangs are assigned to work that they can do safely.

A supervisory officer must be an apostle of safety and keep it uppermost in his mind while planning his work. Unless he believes in it himself he cannot get his subordinates to do so. The engineer may prepare his plans and specifications; he may chart the sequence to be followed in carrying out the work; he may lay out the arrangement for power machines and tools; and suggest the form of organization. It is the supervising officer's responsibility, however, to assign the foremen and men and to see that they are so placed that they will carry out the work with the least likelihood of hinderance or accident.

On the other hand, the supervisor must have the backing of his superiors in every respect, but particularly so with respect to safety. In discussions of work to be done, every step should be planned with the query, "is this the safest way it can be done?" uppermost in mind. If the supervisor then leaves his superior with safety foremost in his mind, he will go over the plans with his foreman in such a way that they will know that the safe way is the only way that the work must be done. In turn, the foreman will watch every move of his men and impress upon their minds that safety is of the first importance.

Should Curves Be Marked?

Is it desirable to employ markers to indicate the degree of curvature? What are the advantages? The disadvantages? What form of marker? Where should it be placed?

Are of Help to Trackmen

By V. C. Hawkins
Division Roadmaster, Great Northern, Whitefish, Mont.

We find it desirable to employ markers to indicate the curve number, the rate of curvature and the elevation of the outer rail. Markers showing this information are helpful to the trackman, who is required to maintain constant supervision over the superelevation of curves, particularly in our mountain territory, where we have a large number of curves within a relatively short distance. With these markers available the trackman is able to check the elevation of any or all of these curves at any time and to correct any errors by using the information shown on the curve marker. There is less chance for error when repairing track that is protected in this manner, since the trackman is not dependent on his memory or upon information copied from a curve record. Furthermore, the track inspector and the supervisor are able to locate definitely work the foreman should do by using the marker as a reference. Inspection parties can also observe readily the degree of any of the curves while passing over them. All of these items combine to promote safer operation and maintenance.

In conversation with many of our enginemen I find that in numerous cases they use the curve markers as a means of determining just where they are, and they seem to be appreciative of the information they thus obtain.

We employ wooden markers 18 in. by 16 in., with a white background and black block letters 5 in. high. The lettering for the elevation and the degree of curvature are in black, 2½ in. high, placed in the lower right and left-hand corners respectively. Points of curve and of tangent are marked permanently by iron pins, and the markers are set on the high side, 14 ft. from the center of the track, at the middle of the curve.

Practice is Desirable

By E. F. Salisbury
Chief Engineer, Kansas City Southern, Kansas City, Mo.

The use of curve markers to locate the points of spiral and of tangent is desirable, but it requires considerable field work on the part of the engineering forces to establish and maintain them. This force is not always available for this work, so that from a practical standpoint it is necessary to resort to alternate methods. Where curve markers are used, I prefer an

iron pin in the center of the track, projecting slightly above the top of the tie. Any other form of marker or other location involves more renewal and will interfere with mowing machines, ballast discers and some other types of power machine.

In all instances, track foremen should be supplied with a tabulation of curve data and, in the absence of curve markers, or of fixing the location of the curves by instrument, string lining is desirable, and in this operation the points of spiral and of tangent should be marked on the rail for the guidance of the track maintenance forces.

Does Not Favor Them

By Supervisor of Maintenance

I do not favor the use of curve markers for several reasons. In the first place, I do not like the appearance of a stretch of track upon which there is a multiplicity of signs, particularly adjacent to the track. We are compelled to erect signs notifying the enginemen of their approach to grade crossings in order that they may comply with state laws that the locomotive whistle must be sounded and the bell rung at or for stated distances from the crossings. We also erect station and yard-limit signs for the benefit of enginemen in controlling their speeds as they approach or enter these limits. We have always done this, in some cases because we are required by law to do so, and in others for safety reasons. More recently, in connection with our high-speed passenger trains, we have also erected permanent speed-restriction signs at certain points, generally in the vicinity of curves that are too sharp to permit maximum speeds.

Some years ago I worked on a road that had markers for all culverts; two markers for open bridges, one at each end to indicate the bridge number; a marker at the middle of curves, and one at each end to record the curvature and elevation. These were in addition to the whistle posts, station signs and yard-limit signs that have been mentioned, and the large mile posts that were a prominent feature of the right-of-way landscape on this road. A new general manager was appointed and on his initial trip over the road one of his first observations was that the multiplicity of signs, all of which contained black letters on a white background, gave the appearance of a graveyard rather than of a railway. He issued a blunt order to remove the culvert, bridge and curve markers, and it was really surprising how the appearance of the right of way was improved. It may also be said that this was done without detriment to maintenance operations.

Another reason why I do not favor the maintenance of these markers is that to be of any benefit they must be placed no further out than the shoulder of the roadbed, where they are in everyone's way. Sometimes they are placed on the berm between the toe of the ballast and the shoulder of the roadbed, which is the poorest location I can think of. Wherever they may be placed, however, they interfere with the operation of off-track machines and particularly with track-mounted mowers.

Preventing Incrustation

To what extent can the incrustation of pipe lines be prevented or reduced in lime-soda ash treating plants? What is the effect on the treated water? On locomotive boilers?

Several Methods Possible

By M. R. Bost
Water Inspector, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The incrustation of pipe lines carrying water treated by the lime-soda ash process is caused by an unstable condition existing in the water after the chemical treatment has been effected. In the cold process, which is far more common than the hot process in railway practice, an excess chemical dosage is required to force the softening reaction toward completion. The presence of this excess treatment, along with some partially treated water from the treating plant, causes an after precipitation of the normal carbonates in the pipe lines. Another factor contributing to incrustation is unsettled sludge which carries through treating plants, that depend solely on settling tanks for clarifying the water.

There are several methods by which incrustation can be reduced or kept at the minimum. The simplest of these is to reduce the rate of the flow of the water through the treating plant to the slowest rate consistent with general operating conditions. This will allow the maximum time for reaction and settling, and will result in the minimum of after-precipitation and sedimentation. Obviously, this will produce a softer and clearer water, which is desirable for locomotive boilers, as it will tend to reduce foaming tendencies.

A second method is to run the water through a filter bed. While this will have no appreciable effect on after-precipitation, it will remove the suspended matter from the treated water.

Again, the treated water can be recarbonated. This will stop the softening reaction of the chemicals, neutralize the excess lime and convert the normal carbonates to bicarbonates. It will, however, result in an increase in the hardness of the treated water and a decrease in the pH value, which encourages boiler corrosion.

A method that is used rarely is to employ an inhibited-acid after-treatment to convert the insoluble carbonates to soluble sulphates or chlorides. However, this treatment forms an excessive amount of carbon dioxide which is difficult to remove. As with the recarbonation process, this method results in increased hardness and an increase in the pH value.

Still another method is to introduce a suitable tannin treatment into the finished treated water. This tends to retard after-precipitation until the water reaches the boiler. In the quantities necessary to prevent incrustation of the pipe lines, tannin has little effect on the treated water. It does tend to remove oxygen and increase slightly the dissolved content of the water and, in the boiler, it also tends to produce an abnormally high methyl-orange alkalinity.

In recent years a new method has been developed, in which a complex phosphate compound is added to the treated water in quantities ranging from one to three parts per million, depending on local conditions. Tests have indicated that this material will not only prevent after-precipitation, but in some cases will remove incrustation already present in pipe lines.

The latter two treatments or a combination of the two are most commonly employed in railway practice. The combination of the organic and phosphate treatments also tends to prevent scale formation in locomotive injectors, branch pipes and boiler checks. The coloring of the water by

the organic treatment is not objectionable as long as it is used for boiler feed-water only.

Methods for controlling incrustation in pipe lines should be determined locally by comparing the cost of the control with the cost of cleaning the pipe lines, keeping in mind that incrusted pipes increase the friction head, which, in turn, increases pumping costs. An important factor, regardless of the method of after-treatment, is adequate supervision of the lime-soda ash softening process, especially where the raw water is subject to variation in quality.

An Inherent Trouble

By Engineer of Water Service

Incrustation is inherent in all pipe lines carrying water treated by the lime-soda ash process. The amount of incrustation caused by after-precipitation depends upon a number of factors, and may be controlled within certain limits. While some incrustation may be expected even with the best of treatment, irregular treatment and insufficient retention time for chemical reactions and sedimentation are the principal causes of excessive deposits. The normal operation of lime-soda ash plants does not permit the removal of all of the solids from the water, and those remaining in the form of carbonates will precipitate and form scale. These deposits will occur in cold water but are accelerated by changes in temperature and in the velocity of flow.

Uniformly correct treatment with adequate time of retention to permit the necessary chemical reactions will prevent excessive incrustation. Well-maintained and well-operated filters will effect a further reduction in after-precipitation and resultant incrustation. The application of certain chemicals, such as organic materials, will retard the chemical reactions in the cold water and tend to prevent the formation of hard scale.

After-precipitation not only results in incrusted pipe lines, but often affects boiler operation seriously through incrustation of feed-water lines, branch pipes on locomotive injectors, boiler checks and feed-water pumps and heaters. It may also increase the tendency of boiler waters to foam, through the precipitation of suspended matter in the presence of a high concentration of dissolved solids.

Painting in Hot Weather

What precautions, if any, should be taken when painting the exterior of buildings in hot weather? Why?

No Special Precautions

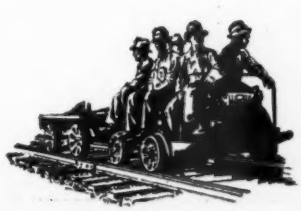
By Supervisor of Bridges and Buildings

Contrary to the belief held by many laymen, no particular difficulties are attached to painting wood surfaces during hot weather. While certain precautions are necessary, they differ only in degree, but not in character, from those required at any other season. If the humidity is also high, however, it may even be necessary to suspend painting operations until the moisture content of the atmosphere is reduced.

In hot weather the paint must be thin if a satisfactory job is to be obtained. For the priming coat, the paint should have an excess of linseed oil, but if paint contains only linseed oil and pigment, the paint will not penetrate the surface and fill the pores of the wood, as is essential for satisfactory painting results. Moreover, the paint will dry quickly, or rather thicken, when it comes into contact with the air and this will also prevent penetration. For this reason, without reducing the oil content of the paint, it pays to be liberal in the use of turpentine.

Paint, well-thinned in this manner, should be brushed thoroughly and persistently to assist in obtaining the desired penetration of and adherence to the surface. If the turpentine is not added, the paint will adhere only to the surface, but will not have the anchorage that is gained by thorough penetration of the pores of the wood, and will shrink and pull away from the surface in the process of drying, causing blisters.

Many woods, particularly conifers, contain resin which is softened and brought to the surface during hot dry weather. When this occurs, the surface should be washed thoroughly with turpentine, to dissolve the resin; otherwise, the resin seals the pores against the paint so that adherence to the surface is faulty. This should be done shortly before the painting is started, so that more of the resin will not work to the surface and make another application of the turpentine necessary. In extreme cases, it may be necessary to give the entire surface a brush coat of clear turpentine before the paint is applied.



Surface Must Be Dry

By B. M. Murdock
Engineer of Buildings, Illinois Central, Chicago

I do not recall any instances of painting failures on exterior surfaces that could be attributed directly to the application having been made during hot weather. This does not mean, of course, that all exterior surfaces painted during hot weather will be perfect, but that where trouble is experienced the failures can be traced to other causes, such as defects in the mixture of the paint, poor workmanship or the painting over damp surfaces. Aside from the personal discomfort of the men working on a hot day, the outside temperature will not reach a point where the temperature of the surface to be painted will be hot enough to affect the paint when applied. As at all other times, to obtain a good and satisfactory job, exterior painting should be done only during a spell of good, dry weather, especially when the paint is to be applied to moisture-absorbing surfaces.

Keep Paint Thin

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

Atmospheric conditions must be taken into consideration when painting the exterior of buildings in hot weather. Under no circumstances during such weather should the paint be too thick, or the spread be too heavy. If the temperature is high and the humidity is low, the heavy coat will dry quickly on the surface, but the under vehicle will tend to volatilize, making bubbles. If the atmosphere is very humid the thick coat will remain "tacky" for a long time, and may run or blister. Both of these conditions will result in a poor and unsatisfactory painting job.

The paint should be thinned to a point where it can be spread readily in a thin and uniform coat, and then allowed to dry to a point at which painters say it has a tooth, that is,

to a point where the surface is slightly sticky and not glazed. The second coat, of about the same consistency, should then be applied in the same manner as the first one. If the first coat is too dry, the second coat will not "mesh" with it; if it has not been allowed to dry sufficiently, the second coat may blister.

If suitable care is taken, there is no reason why painting cannot be done as satisfactorily during hot weather as at any other season. The main thing is to spread the paint thin and evenly and then cover this with a second thin coat as soon as the priming coat is just dry enough, but not too dry, to hold the cover coat.

Causes of Sun Kinks

What are the causes of sun kinks? How do they develop? What can be done to prevent them?

Frozen Joints One Cause

By G. L. Sitton
Chief Engineer Maintenance of Way and Structures, Southern, Charlotte, N. C.

Insufficient room for expansion of the rail as the temperature increases is the primary reason for the buckling of track. The danger of buckling is greatest when there are sudden changes in temperature from cold to hot, such as occur during the spring months, and exceptional precautions should be taken during this period. Where bolts have been tightened by machine, it is possible that they will be so tight that the track will buckle before the rail is able to exert enough force in expansion to slip through the joint bars.

Foremen should be cautioned that in checking up on the expansion allowance, they should remember that practically all rail that is being laid today has been chamfered at the ends, and it is impossible to determine how much expansion allowance is available by looking only at the joint gap as it appears at the running surface of the rail.

Rail should be laid with the correct expansion allowance and then anchored adequately before traffic is allowed to move over it. If it becomes tight from any cause at a later date, the joints should be loosened up and the rail driven back until the correct expansion allowance has been obtained. It is better to spend the money to drive back the rail than it is to allow the hazard of tight rail and the possibility of buckling track to remain.

Numerous Causes

By G. S. Crites
Division Engineer, Baltimore & Ohio, Baltimore, Md.

It may be that when the rail was laid correct expansion allowance was not made, so that too much rail was installed in the first place. If this was done nothing is left except to cut out a section of rail and even the joints, since no amount of anchorage will avoid the probability of sun kinks under this condition when there is a sudden increase in temperature. Rail that is laid too tight will show evidence of stress at the joints and over places where the spikes do not hold the tie plates or the rail securely, long before the rail is ready to jump off the roadbead. Such places should be taken care of as soon as these indications make their appearance if trouble is to be avoided.

Probably the most prolific source of sun kinks is unstable roadbed. The whole roadbed, just the upper part of it, or the ballast section alone, may undulate with wave action under trains, and will cause the rail to creep in the direction of the heaviest traffic. No amount of rail anchorage will correct a condition of this kind to a satisfactory degree.

Directional traffic on multiple-track lines and preponderant traffic on single track tend to cause the rail to creep. This can be overcome by a full-ballast section, good line and surface and adequate anchorage of the rail, yet steps should be taken to keep the expansion allowance adjusted and distributed uniformly at all times. Poor maintenance will encourage the creeping of the rail.

Two Main Causes

By L. L. Adams
Assistant Chief Engineer, Louisville & Nashville, Louisville, Ky.

There are two main causes of sun kinks, (a) insufficient expansion allowance when the rail was laid, and (b) frozen joints. Where sufficient expansion allowance has not been made when the rail was laid, there is always a tendency for the track to buckle, and, as the joints cannot be spiked as securely as can be done on the intermediate ties, any tendency for the rail to be forced out of line will show first at the joints.

When joints open during cold weather and are allowed to freeze in this condition, the effect is the same as if the rail was laid originally without sufficient expansion allowance. This situation also develops sometimes because the rail is not anchored securely; it shifts or creeps, causing tight joints at one point and open joints elsewhere. If the rail does not creep back to its former position during hot weather it very often develops kinked joints.

When conditions such as those mentioned exist, the joints will be forced out of line during the first hot days in the spring, showing first as very slight kinks, but increasing in magnitude as the temperature rises. Sun kinks can be prevented by using suitable spacing between the ends of the rails when laying the rail to allow for expansion, by anchoring the rail securely before traffic is permitted to pass over it, and by maintaining the bolt tension at all joints so that the movement in expansion will be free and uniform at all joints, thus preventing the joints from freezing. If this is done there will be no occasion for sun kinks.

There Are Many Causes

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

While the primary cause of buckling track is the expansion of rail under rising temperature where an insufficient expansion allowance has been made, there are numerous contributing causes. A rail one mile long, if allowed to move freely and without restraint, will increase in length approximately 42 in. under a temperature rise of 100 deg. If restrained at the ends, as it is in effect when laid without sufficient expansion allowance, high internal stresses are developed and, in an effort to release these stresses, the rail tends to buckle.

One of the first indications of this tendency to buckle is usually a slight kinking at the joints, followed by slight sinuosity in the line, especially where spikes are loose, although heavy rail and double-shoulder tie plates minimize these indications in the general line somewhat. As the rail becomes tighter with increased expansion, these kinks increase in magnitude, but it may be only slightly, and rail that is ready to jump its bed may show only minor indications of the stress it is under.

Irregular line, irregular gage, a skimpy ballat section, loose spiking,

frozen joints and generally poor maintenance all contribute to sun kinks and buckling track. The only sure way of avoiding this trouble is to provide the expansion allowance necessary to relieve the rail of the stresses that are set up by the restraint that is provided by tight rail.

Overdriving Piles

What methods should be employed to prevent the overdriving of piles through hard soil, but not to rock, when deep penetration is required? Does this differ for wood, concrete and steel piles? How? Why?

Jetting Used Widely

By Supervisor of Bridges and Buildings

Ordinarily, this territory does not have many places, although there are a few, where hard strata, such as hardpan or formations approaching hardpan, are encountered. In general, our line passes through glacial deposits of such thickness that sedimentary deposits are below the range of pile driving. We do, however, encounter compacted clay that offers high resistance to the driving of piles; sand deposits, some of which are as fine as quicksand; and reasonably thick gravel strata.

Where we encounter excessive resistance in the compacted clay we can generally overcome the difficulty by using a single jet, although we have had several cases where twin jets were required. We have also met some difficulty in reasonably soft and plastic lay when we attempted to drive groups of foundation piles on close centers. In one instance we were to construct a tall stack in a location where the soil did not have the desired load-bearing power. To provide against settlement, the plans called for 30 rows of 30 piles each on 18-in. centers, that is, the piles in place were virtually touching each other.

We started the driving at one side with the purpose of progressing straight across the foundation. The first piles went down without difficulty, but after a few rows, we could not obtain the required penetration and the piles that were already driven developed an insistent disposition to rise as additional piles were driven alongside them. We then drove the outside rows on all sides, making an enclosure, then the second row inside them. When we began to drive the third inside row, however, the two rows already driven not only began to rise, but some of those in the outside row started to tilt outward. We then resorted to jetting and finished the job with no further difficulty of consequence.

These piles were to be capped with a reinforced concrete slab, and I felt some uneasiness about the ability of the jetted piles to carry their share of the load, but the stack has been in service for a number of years and has as yet shown no tendency to settle unevenly, although there was some initial settlement. I have often thought that in driving the outside piles without using the jet it may be that we had so compacted the soil that it offered support to those piles in the center that were jetted.

We often encounter sand deposits through which it is almost impossible to drive piles without damaging them. In such instances I know of only one solution, this being resort to the water jet. In general, a pile that has been jetted through a thick bed of sand is as stable and has as much load-bearing power as one that has been driven without the jet, because, the surrounding sand will settle against it and grip it tightly as soon as the jet has been withdrawn. On the other hand it may be some time before a pile jetted through a hard compacted clay reaches its maximum load-bearing capacity.

If the strata through the pile is to be driven contains hardpan or other formation approaching shale of considerable thickness, that does not respond to the water jet, or a relatively thick bed of gravel is encountered, about the only remedy is to drill holes for the piles through the lowest of the refractory strata. I do not favor this method except as a last resort, however, because one loses the benefit of skin friction in assisting the pile to perform the function for which it is intended.

What has been said applies equally to wood and concrete piles. Steel piles can be driven without damage through formations that would wreck wood or concrete piles.

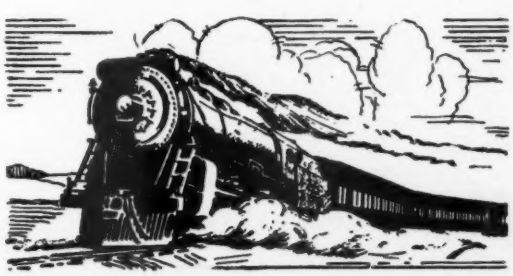
There Are Several Methods

By General Inspector of Bridges

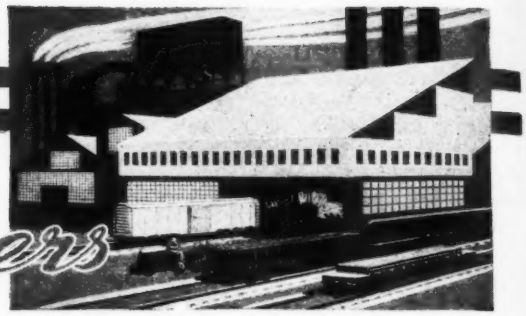
Although the question limits the conditions under which the driving is to be done to hard soil, there are situations, such as thick sand strata, particularly deposits of quicksand, that may be as difficult to drive in as hard strata. Some years ago I was in charge of a project that required the driving of approximately 18,000 piles. The specifications required that they be driven to rock, which ranged from 37 to 60 ft. below cut-off. By means of test piles we found that it would be impossible to do this through straight driving, as we battered every one of our test piles to pieces in an effort to get them down. Test borings taken previously had shown a bed of sand ranging from 15 to 30 ft. thick, and a jet solved the problem easily.

On several occasions where it has been necessary to obtain a specified penetration through hard strata, we have resorted to boring holes for the piles and have obtained good results from this method. To obtain best results, however, one must have straight piles of approximately the same diameter throughout their length. A crooked pile is quite likely to break if an attempt is made to force it into a straight hole that is slightly smaller than the diameter of the pile.

If, as the question implies, the strata through which the pile must penetrate are hard and unyielding, the preboring of the pile hole seems to be the only practical solution of the problem. But, since the hole must have the same diameter throughout its depth, a tapering pile will receive no support for a considerable part of its length, so that its load-bearing ability may be impaired. Although I have never seen this done, I have heard it advocated that the holes be made slightly larger than the butt diameter of the piles, and that after the pile has been set, the hole be backfilled with sand or cement grout.



PRODUCTS of Manufacturers



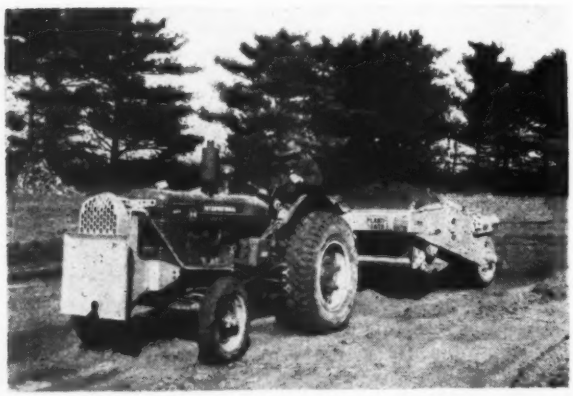
LaPlant-Choate Scraper

A RECENT development of the LaPlant-Choate Manufacturing Company, Inc., Cedar Rapids, Iowa, is a two-yard front-dump scraper, Model CW-2, which is an improved counterpart of a scraper developed for the armed forces.

The new scraper has a weight of 2250 lb. The design is such that the two rear wheels can be located either inside or outside the cut, and the scraper is said to be able to make turns up to 90 deg. within a circle diameter of 20 ft. The hitch is designed for operation behind high-speed rubber-tired industrial tractors. When fully loaded, the weight is lifted from the front wheels of the tractor, with much of it being centered on the tractor's driving wheels to give maximum traction. The bowl and apron are operated hydraulically by a LaPlant-Choate airborne pump. A three-position valve enables the cutting edge to be held in position and to exert effective down pressure.

Other operating features claimed for the scraper include the ability to make cuts up to 11½ in. and to produce smooth finished work. It is said that it can be loaded in all types of scraper material without the aid of a pusher, or that it can be loaded through the open top as there is no overhead obstruction to the bowl. Because of its low center of gravity it is said that the scraper will not roll over on any slope that will hold the tractor. Its rubber-tired equipment is designed for high road speeds, but it can be used on or off pavements for hauling. The bowl clearances and the short wheel base permit the scraper to be used either on soft fills or rough terrain.

Because of these operating features, it is claimed that this scraper can be used economically on many small earth moving jobs previously considered to be outside the scope of scraper operation. Included in this work are the construction of small dams, the back-filling of bridges and foundations, the cleaning of ditches and clearing of slides, and general earth-hauling work.



The LaPlant-Choate Model CW-2 Scraper

Emergency Compressor-Generator with Floodlights

SCHRAMM, Inc., West Chester, Pa., has added a trailer-type compressor-generator outfit, equipped with floodlights, to its line of equipment which may be used for various railroad maintenance, repair and construction projects, and which is especially adapted for night emergency work requiring artificial illumination.

Briefly, this completely self-contained unit, which is exceptionally compact, consists of a standard Schramm engine-compressor, minus any chains and gears, with a generator and two fixed 200-watt floodlights, all mounted on a pneumatic-tired two-wheel spring trailer. The engine-driven four-cylinder compressor has an actual air delivery of 60 cu. ft. at 100 lb. gauge pressure, while the generator will deliver 5 kw. of 60-cycle, single-phase alternating current at 110 volts; or, the unit will deliver simultaneously compressed air and electric current to the extent of the engine horsepower. A safety vacuum control limits the supply of air when an electric load is being carried and the control panel contains such control devices as a voltmeter, field rheostat, panel lights, low voltage cut-out and engine control.

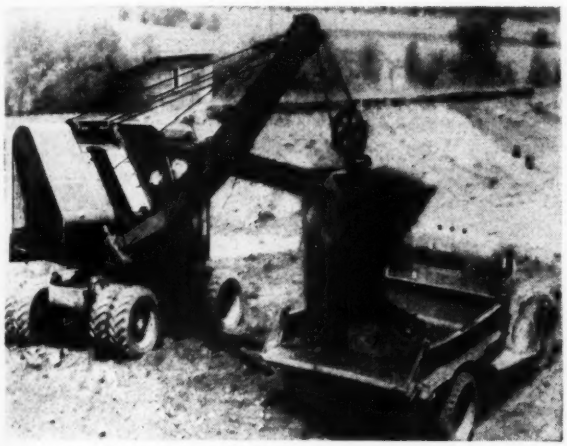
The New Schramm Emergency Compressor-Generator

Link-Belt Unit With Wheel Mounting

A RECENT development of the Link-Belt Speeder Corporation, Chicago, is a wheel-mounted utility unit, known as Model UC-55, which is adaptable for operations as a crane, a dragline, a shovel, a clamshell, a pile driver or a trench hoe. This

machine is mounted on dual wheels equipped with pneumatic tires, and has an overall width of 8 ft., a wheel base of 7 ft. 6 in., and a weight of approximately 26,350 lb. when equipped as a shovel. It has four travel speeds in either direction ranging from one to ten miles an hour, and a four-wheel drive.

Other features include automatic hydraulic stabilizers which lock the oscillating front axle in any position, and hydraulic brakes which lock the machine against involuntary movement when digging. This unit is a ½-cu. yd. machine and has a lifting capacity of six tons. Equipped as a pile driver with a 30-ft. boom, it can drive piles at the rate of 4 to 6 blows per minute. It is said that the machine can be quickly converted from one use to another by changing the front end attachment, and that it is easily steered from the operator's position in the cab by hydraulic power.



The New Link-Belt Utility Unit Operating as a Shovel

Acid-Resistant Wood

A TREATMENT for soft wood lumber to produce an acid-resistant material, named Asidbar, has been developed by the Koppers Wood Preserving Technical department, Orrville, Ohio. This treatment makes the wood resistant to chemicals, acids, moisture, decay and wear, and suitable for the requirements of severe service conditions at temperatures up to 180 deg. F. Because of these qualities, it should be of value for construction in and near locomotive terminals or industrial areas where exposure to severe corrosive gases may cause rapid deterioration of most construction materials. Because of its increased hardness and wearing qualities, wood thus treated also has possible applications for platform flooring and other construction where it may be subject to rough usage.

The treatment is applied by immersing the wood in a heavy coal-tar plastic in sealed retorts. The plastic is forced into the wood fibers by high pressure at temperatures sufficiently high to hold the compound in a liquid state. After an impregnation period of 10 to 20 hours, the compound sets in the cells of the wood as it is allowed to cool, to produce the material known as Asidbar. The treatment increases the weight and hardness of the wood, gives it a black surface which need not be painted, and resistance to wear, abrasion, water and chemicals are considerably increased.

Wood thus treated can be installed with ordinary tools. In applications where expansion or shrinkage are detrimental, the treatment substantially decreases changes of shape and dimensions when the wood is subject to alternate wetting and drying. Wear resistance also is increased by the increased hardness and other properties given to the wood when treated by the plastic.

Tests have been made to establish the resistance of Asidbar to acid and acid fumes. In one application in a spray-type pickling machine, Southern yellow pine guides treated by this process were subjected to 10 to 15 per cent sulfuric acid at a temperature of 180 deg. F. and it is said that the acid-resistant wood was sound and firm after 18 months of service. Untreated wood in this same service, it is reported, lasted only two to three weeks. Fume ducts exhausting the acid fumes from the same machine were built of acid-resistant treated wood, and have given similar service. Metallic alloy flues lasted only a short time, while untreated wood fell apart after two weeks of exposure.

New Book

Bridge Builders

THE BUILDERS of the Bridge, by D. B. Steinman. 457 pages, 5½ in. by 8 in. Published by Harcourt, Brace and Company, 383 Madison Ave., New York 17, N. Y. Bound in cloth. Price $3.50.

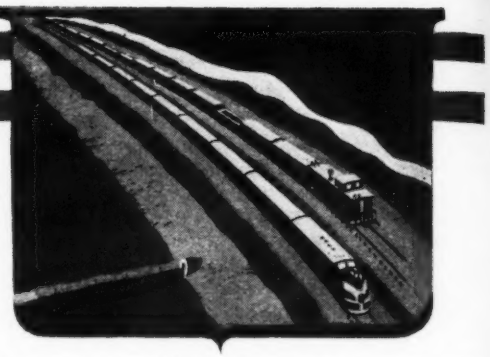
A biography, this book records the life and achievements of two prominent engineers, John Roebling and his son, Washington Roebling, who fought for years to prove that suspension bridges could be built to carry heavy loads safely over the longest conceivable spans. This biography tells of the education of John Roebling in Germany, his thirst for knowledge, his training in engineering, and his emigration to America in 1831, where he founded a farming colony in Pennsylvania. A few years later he turned to engineering work, surveying canals, river improvements, portage railways, turnpikes and steam railroads. He also patented an invention for wire rope and established his own wire rope mill at Saxonburg, Pa., later moving it to Trenton, N. J.

At the same time, Roebling continued his engineering activities and built the world's first suspension aqueduct over the Allegheny river at Pittsburgh, Pa. This was the first step toward his real ambition, to build a suspension bridge. Next, the biography describes the construction of the Monongahela suspension bridge at Pittsburgh, the Delaware river suspension aqueduct at Lackawaxen, Pa., the Niagara railway suspension bridge and the Ohio River suspension bridge at Cincinnati, Ohio.

Interwoven into the later chapters are the training and development of young Washington Roebling. Finally, the book tells in considerable detail of the planning and construction of John Roebling's dream span, the Brooklyn bridge.

The pages of this biography contain much historical data on engineering development and problems in the period from 1837 to 1883. The book is interesting also from a narrative standpoint, as it reveals the prejudices of the times and the obstacles to success that were overcome one by one by the Roeblings.

NEWS of the Month



N.P. Grows Own Ties

To assure itself of a permanent supply of ties, lumber and other forest products necessary to successful railway operations, the Northern Pacific has established two "tree farms" in western Montana, embracing more than 100,000 acres of timberland. Establishment of a third tree farm is contemplated.

According to J. M. Hughes, land commissioner of the road, the Northern Pacific's annual cross-tie requirements are in excess of 1,250,000 ties, in addition to vast quantities of lumber and other forest products. He explained that although the railway had long obtained ties from its own joint holdings, it was not until recently that selective cutting and reseeding practices were made effective. The Montana tree farms are expected to supply the road's requirements for softwood ties.

Feb. 28 to Mark End of Mexican Employment in U.S.

The Railroad Retirement Board and the War Manpower Commission have revealed that the employment of Mexican nationals on U.S. railroads would be terminated by the end of February. It was explained that prior to August 18, the W.M.C. was negotiating new six months contracts with certain carriers and 90-day renewal contracts with others, but that on that date all such activities were stopped. At that time there were approximately 67,000 Mexican nationals at work on American railways, primarily in track maintenance gangs. It is estimated that the following number of Mexican nationals will be engaged in railway employment in this country at the end of each month until next February 28, when all will have left: September 30—48,117; October 31—33,357; November 30—20,661; December 31—12,223; January 31—7,499.

Air Lines Open Drive For Rail Passenger Traffic

Many of the nation's air lines have recently announced reductions in their passenger fares to bring them down to or below the charges of first-class rail transportation plus lower berth, although round-trip first-class rail fares, plus berth charges, and western line tourist class fares, and all-coach fares, still remain substantially less than the new air transportation charges.

The air lines at the present time are in a favorable position with regard to passenger traffic competitive with the railways, in that the military demands for air travel via commercial air lines has virtually ceased. The railways, on the other hand, are experiencing the heaviest military movements of the war due to the rapid return of military personnel from overseas, are still forbidden to operate sleeping cars on runs of 450 miles or less, are required to withdraw coaches from regular trains when needed for troop movements, and are still reserving considerable space in regular trains for use by small groups of military personnel.

Brunner Memorial Established

With funds bequested by the late Mrs. Cora M. Brunner of Evanston, Ill., as a memorial to her husband, John Brunner, the University of Illinois has established the Brunner Memorial Endowment for Research and Advancement in Engineering Education.

Mr. Brunner, who died in 1936, was a noted metallurgist, born and educated in Sweden, who came to this country in 1866, working for various railways, and bridges and steel companies in the East. In 1902 he came to Chicago as head of metallurgy and inspection of the Carnegie-Illinois Steel Corporation. From the time of his arrival in Chicago until his death, Mr. Brunner actively co-operated with the University of Illinois in its research in rails and metals, becoming a member of the University Advisory Committee on Rail Investigation in 1931, and serving in this capacity until his death. In 1931 he devised the "Brunorizing" process, a treatment designed to prolong the life of rails by preventing the formation of shatter cracks, generally believed to be the nuclei of transverse fissures.

More Streamliners Ordered

Additional streamlined passenger trains have been announced by a number of roads recently. The Missouri Pacific Lines and the Texas & Pacific have placed orders for new car equipment and diesel-electric locomotives for the present "Sunshine Special" trains operating between St. Louis Mo., and Texas points. In the same territory the "Texas Special" of the Frisco-Katy Lines is also to be provided with modern equipment. In South Texas, the Missouri Pacific has announced its plan to inaugurate high-speed, streamlined passenger train service daily between Houston, Tex., Corpus Christi and Brownsville.

In the East, the Chesapeake & Ohio has ordered equipment for a fast deluxe daylight streamliner between Cincinnati, Ohio, and Washington, D. C. In the West, several roads have also ordered or announced their intention of placing orders for substantial amounts of new passenger equipment. The largest order for complete trains so far announced among these roads is one by the Burlington for two new seven-car "Twin Zephyrs," embodying the "Vista Dome" in all passenger-carrying cars (a description of this "Dome" will be found on page 890 of the September issue), for service between Chicago and the Twin Cities, and a new 12-car "Empire Builder" train, this road's share of the new equipment planned for the latter train operated jointly by the Burlington and the Great Northern. The Burlington, in connection with the Denver & Rio Grande Western and the Western Pacific is also planning the purchase of 60 new streamlined cars to re-equip the "Exposition Flyer," operated daily by those roads between Chicago and San Francisco, Cal. These cars will also feature the "Vista Dome."

The Southeastern roads operating between Chicago and Florida have also announced plans for the construction of three new 14-car diesel-powered streamliners to operate on alternate-day schedules of 29 hours via each of three routes.

I.C.C. Reopens Case Involving Accounting for Post Driving

Reopening its No. 29140 investigation involving accounting for the cost of driving posts into the roadbed at the ends of the ties to stabilize the track, the Interstate Commerce Commission has broadened the proceedings to make respondents of all Class I roads. It has further broadened the scope of the inquiry to include the question of whether expenditures for pressure grouting to promote the stability of roadbeds shall be charged to operating expense account No. 202, Roadway Maintenance, or investment account No. 3, Grading.

As noted in the May issue, page 497, Division 1's prior report, which described this proceeding as one involving "the fundamental distinction in accounting between capital expenditures and operating costs," found that the cost of the post driving was a capital investment, chargeable to account No. 3, Grading. Only the cost of removing the ballast and resurfacing was found chargeable to operating expenses. At that time the respondents were the Texas & Pacific, Texas & New Orleans, and Louisiana & Arkansas, and they contended that the entire cost of the post driving should be charged to operating expenses. The present reopening order postpones Division 1's order indefinitely.

Changes in Railway Personnel

General

N. N. Baily, assistant general manager of the Reading, and an engineer by training and experience, has been promoted to general manager, with headquarters as before at Philadelphia, Pa.

Frederick McQ. Falck, assistant vice-president, personnel, of the Reading, at Philadelphia, Pa., and an engineer by training and experience, has retired.

G. J. Willingham, assistant to the vice-president and general manager of the Illinois Central, at Chicago, and an engineer by training and experience, has been promoted to manager of personnel, with the same headquarters. Mr. Willingham was born in Mayfield, Ky., and entered railway service as a rodman on the Illinois Central, at Fulton, Ky. He subsequently served as instrumentman, general foreman, resident engineer, track supervisor, supervisor of trains and tracks, trainmaster, division superintendent and assistant to the vice-president and general manager.

Walter S. Moore, whose promotion to division superintendent on the Louisville & Nashville, with headquarters at Louisville, Ky., was reported in the August issue, was born at Fresno, Cal., on January 13, 1886, and received his higher education at Vanderbilt University, Nashville, Tenn. He entered railway service in 1907 with the L.&N., at Nashville, subsequently holding various positions in the engineering department at that point and at Paris, Tenn., and Pensacola, Fla. In 1913 Mr. Moore was promoted to engineer maintenance of way of the Louisville & Atlantic (part of the L.&N.), with headquarters at Versailles, Ky., and three years later he was transferred to the Louisville, Henderson & St. Louis (also a part of the L.&N.), with headquarters at Louisville. In 1931 he was advanced to division engineer on the L.&N., at Louisville, the position he held at the time of his new appointment.

Engineering

R. E. Farmer, formerly division engineer on the Canadian Pacific, at North Bay, Ont., has been appointed division engineer at Smiths Falls, Ont.

Edward H. Taylor has been appointed special engineer, office of the president, of the Chesapeake & Ohio, at Cleveland, Ohio, succeeding **W. C. Pinschmidt,** whose promotion to engineering assistant to the vice-president was reported in the August issue.

W. Walkden, whose retirement as bridge engineer of the Western Region of the Canadian National was reported in the August issue, entered railway service in 1907, as a draftsman, at Winnipeg. In 1916, he was advanced to assistant engineer, and in 1918 he was promoted to bridge engineer, remaining in that position until his retirement. Mr. Walkden designed many of the largest bridges on the Western region of the Canadian National, including the Dunblane bridge over the South Saskatchewan river and the 4,300-ft. trestle leading to the new ore dock at Port Arthur, Ont.

H. Bober, assistant engineer of bridges of the Chicago, Rock Island & Pacific, at Chicago, has been appointed bridge and building engineer of the Alton, with headquarters at Chicago, succeeding **W. F. Rech,** whose death on July 24, was reported in the August issue.

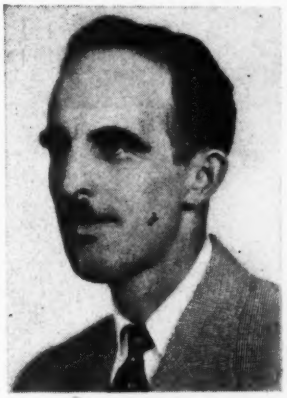
George L. Morrison, division engineer on the Southern Pacific, at Dunsmuir, Cal., has been promoted to assistant engineer maintenance of way and structures, with headquarters at San Francisco, Cal. **J. E. Wheeler,** assistant division engineer, with headquarters at Tucson, Ariz., has been advanced to division engineer at Dunsmuir, succeeding Mr. Morrison.

Robert C. Young, whose promotion to division engineer of the Louisville division of the Louisville & Nashville, at Louisville, Ky., was reported in the August issue, was born at Altamont, N. Y., on August 13, 1890, and received his higher education through the International Correspondence Schools. He entered railway service as a rodman on the Memphis line of the L. & N. in September, 1914. He was promoted to instrumentman in February, 1915, and to assistant engineer in October, 1917, serving in the latter capacity on the Memphis line and the Cincinnati and Birmingham divisions. In March, 1942, Mr. Young was promoted to assistant division engineer of the Louisville division, and on January 1, 1945, he was further advanced to acting division engineer of that division, remaining in that position until his promotion.

St. John Munro, whose promotion to district engineer of the British Columbia district of the Canadian National, at Vancouver, B. C., was reported in the September issue, was born on June 24, 1887, in Lancashire, England, and received his higher education from Victoria University, Manchester, England. He entered railway service in August, 1907, in a location party on the Canadian Northern (now Canadian National), at Winnipeg, Man. In 1912, he was promoted to resident engineer at Resplendent, B. C., being transferred to Vancouver in 1916. From 1917 to 1920, Mr. Munro was loaned to Pratt & Ross as supervisory engineer on the Vancouver terminals of the Canadian National, becoming division engineer at Kamloops, B. C., on his return to the railway. In 1929 he was transferred in the same capacity to the Vancouver Island lines, at Victoria, B. C., the position he was holding at the time of his recent promotion.

John L. Southard, whose promotion to assistant division engineer on the Chesapeake & Ohio, with headquarters at Columbus, Ohio, was reported in the September issue, was born at Marysville, Ohio, on November 26, 1901, and graduated in mining engineering from Ohio State University in 1924. He entered railway service on January 1, 1925, as a chainman in the engineering department of the Hocking division of the Chesapeake & Hocking (later the Hocking Valley, now part of the C. & O.) at Columbus, Ohio. In 1927 he was promoted to rodman and the following year to instrumentman. Mr. Southard was appointed an assistant cost engineer at Marion, Ohio, in 1929, and was transferred to Walbridge, Ohio, in 1931, and to Columbus in 1933. On December 16, 1940, he was advanced to supervisor of track of the Columbus Terminal of the Chesapeake & Ohio, with headquarters at Columbus, which position he held until his recent promotion.

Thomas D. Saunders, whose promotion to chief engineer of the Temiskaming & Northern Ontario, with headquarters at North Bay, Ont., was reported in the August issue, was born in Winnipeg, Man., on



Thomas D. Saunders

May 14, 1901, and attended the Toronto Technical School and the University of Toronto. After serving as a draftsman with the firm of Ewart, Jacob Armer & Byam, consulting engineers at Toronto, he entered railway service on April 1, 1924, as a rodman on the Canadian National at Toronto, being subsequently advanced to instrumentman and later to assistant division engineer of the Toronto Terminals division. On October 31, 1940, Mr. Saunders went with the Temiskaming & Northern Ontario as assistant to the chief engineer at North Bay, which position he held until his recent promotion.

Leo W. Green, whose promotion to assistant division engineer on the Pennsylvania, with headquarters at Altoona, Pa., was reported in the August issue, was born at Swayzee, Ind., on January 14, 1909, and attended Purdue University. Mr. Green entered railway service on June 20, 1930, as an assistant on the engineer corps of the Pennsylvania at Lewistown, Pa., and, except for a period of about nine months in 1931, when he was an assistant supervisor of track at Lock Haven, Pa., he continued in this capacity at various points until April 1, 1934, when he was re-appointed assistant supervisor of track at Wilmington, Del. He was transferred to Lewistown on

October 10, 1935, and to Downington, Pa., on May 1, 1937. On February 20, 1938, he was advanced to supervisor of track at Buffalo, N. Y., and three months later he was appointed assistant supervisor of track at Derry, Pa. He was appointed supervisor of track at Lock Haven on January 15, 1939, which position he held until his recent promotion.

Millard J. Hubbard, whose promotion to division engineer of the Chesapeake & Ohio, with headquarters at Columbus, Ohio,

Millard Hubbard

was reported in the August issue, was born at Mayfield, Ky., on September 18, 1906, and graduated in civil engineering from the University of Kentucky in 1930. Mr. Hubbard entered railway service on June 3, 1930, as a carpenter helper on the C. & O. at Ashland, Ky., and was promoted to first grade carpenter on March 1, 1933. On November 12, 1934, he was appointed an instrumentman on the engineer corps at Richmond, Va., and on October 1, 1937, he was advanced to assistant cost engineer at Hinton, W. Va. From March 1, 1939, to December 1, 1943, Mr. Hubbard served as assistant yardmaster at Handley, W. Va., and on the latter date he returned to the engineering department as assistant division engineer at Columbus, Ohio, which position he held until his recent promotion, effective June 16.

L. G. Curtis, whose retirement as chief engineer of the Baltimore & Ohio Chicago Terminal was reported in the August issue, was born at Hamilton, Ohio, on November 28, 1874, and is a graduate of Ohio State University. He entered railway service in 1892 as a rodman on the Columbus, Sandusky & Hocking (now the Pennsylvania), later resigning to enter another field. In 1899 he returned to railway service as a civil engineer in the maintenance of way department of the Baltimore & Ohio, with headquarters at Zanesville, Ohio. In 1900 he was appointed assistant engineer maintenance of way, and two years later he was promoted to assistant division engineer at Chicago. In 1903, Mr. Curtis was advanced to division engineer, with the same headquarters, and in 1910 he was promoted to engineer maintenance of way, also at Chicago. In 1914 he was advanced to district engineer of the B. & O. C. T., and in 1918 he was promoted to assistant chief engineer of the B. & O., with headquarters at Baltimore, Md. In 1924 Mr. Curtis was advanced to the position he held at the time of his retirement.

John F. Marsh, chief draftsman of the bridge department of the Chicago, Rock Island & Pacific, has been promoted to assistant bridge engineer, with headquarters as before at Chicago, succeeding **H. Bober,** whose appointment as engineer of bridges and buildings of the Alton is reported elsewhere in these columns. **C. Jacobsen,** a designer, has been advanced to chief draftsman, succeeding Mr. Marsh. Mr. Marsh was born in Des Moines, Ia., on July 15, 1906, and was graduated from Iowa State College, at Ames, Ia., in 1928, with the degree of B.S. in C. E. In the latter year he entered the employ of the Chicago Bridge & Iron Company as an assistant engineer in the construction division at Chicago, later serving as an estimator in the New York sales office. In 1932 he went with the Marsh Engineering Company, Des Moines, as designing engineer. He entered railway service in 1935, as a designer with the Rock Island, at Chicago, and in 1939 he was advanced to chief draftsman, holding this position until his recent promotion.

Edwin F. Wright, whose promotion to regional engineer of the Baltimore & Ohio, with headquarters at Pittsburgh, Pa., was reported in the September issue, was born at Baltimore, Md., on March 5, 1901. He graduated from Baltimore Polytechnic Institute in 1920 and attended Cornell University from 1920 to 1922. Mr. Wright en-

Edwin F. Wright

tered railway service on April 23, 1923, as a rodman on the Baltimore & Ohio, later serving as levelman, transitman and field engineer at Pittsburgh, Pa. In 1933 he was transferred to Staten Island on grade crossing elimination work, and in 1936 he returned to Pittsburgh. Mr. Wright was assistant engineer at Pittsburgh prior to his recent promotion to regional engineer.

E. Carl Shreve, whose appointment as chief engineer of the Western Maryland, in charge of construction and maintenance of way, was reported in the September issue, was born on December 7, 1903, at Branch, W. Va., Mr. Shreve was graduated in civil engineering from Ohio State University in 1928, receiving an M.S. degree in 1929 and a C.E. degree in 1935. He entered railroad service on June 10, 1940, as assistant engineer of the Western Maryland at Baltimore, becoming assistant division engineer at Hagerstown, Md., in August of that year. He was promoted to division engineer, with headquarters at Cumberland, Md., on September 15, 1942, and in June, 1944, he was appointed engineer maintenance of way, the position he held at the time of his recent promotion to chief engineer. Prior to entering railroad service Mr. Shreve had been employed in connection with the U. S. Geological Survey and the West Virginia State Road

E. Carl Shreve

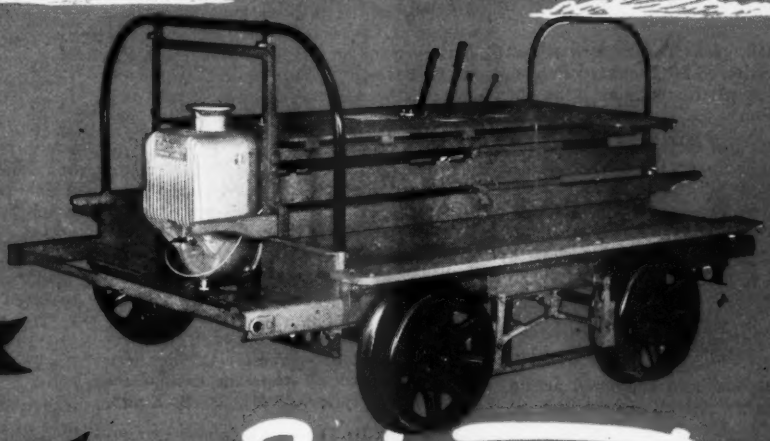
Commission. He also served for a time as head of the engineering department, Potomac State School of West Virginia University.

E. R. Shultz, engineer maintenance of way of the Northwestern district of the Pennsylvania, with headquarters at Chicago, has been promoted to chief engineer maintenance of way of the Eastern region, with headquarters at Philadelphia, Pa., succeeding **Walter R. Parvin,** whose death on July 28 was reported in the September issue, and **M. C. Bitner,** division engineer of the New York division at Jersey City, N.J., has been advanced to engineer maintenance of way, Northwestern district, at Chicago, replacing Mr. Shultz. **J. M. Fox,** engineer maintenance of way of the Eastern Pennsylvania general division, with headquarters at Harrisburg, Pa., has been promoted to assistant to the chief engineer, Eastern region, with headquarters at Philadelphia, a newly created position, and **H. J. Kerstetter,** division engineer at Philadelphia, has been advanced to engineer maintenance of way of the Eastern Pennsylvania general division, relieving Mr. Fox. **K. L. Silvey,** division engineer of the Columbus division at Columbus, Ohio, has been transferred to the New York division, at Jersey City, succeeding Mr. Bitner, and **T. M. Goodfellow,** assistant division engineer of the Philadelphia Terminal division, has been promoted to division engineer at Columbus, replacing Mr. Silvey. **W. C. Gretzinger,** supervisor of track on the Middle division, with headquarters at Newport, Pa., has been advanced to assistant division engineer of the Philadelphia Terminal division.

John W. DeMoyer, whose promotion to assistant division engineer on the Reading at Philadelphia, Pa., was reported in the September issue, was born on February

(Continued on page 1044)

LEADERSHIP



SAFETY

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POWER

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RAILWAY MOTOR CARS

The prestige of leadership is counterbalanced by responsibility . . . by the obligation to keep reaching beyond the accepted standard for improvement; by the willingness and ability to serve, not merely well, but *better.*

The S2 Series F standard section car—illustrated above—reflects the trend of Fairmont thinking for the production of cars that will deliver the broadest range of service. The fact that this car will seat eight men and is also a safe unit for one-man operation demonstrates what engineering can do for economical flexibility. By using hi-strength steel in a scientifically balanced chassis, the rear lifting weight of this big car is held to a low of 148 lbs. Here again, Fairmont's 8-13 h.p. RQ Hy-Load Roller Bearing Engine furnishes surplus power for peak-load performance. All details in Bulletin 394. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Performance ON THE JOB COUNTS

OF ALL THE CARS IN SERVICE TODAY...MORE THAN HALF ARE FAIRMONTS

16, 1905, at Pottsville, Pa., and was educated at Lehigh University, from which he was graduated in 1927. Immediately following graduation, he entered the service of the Reading as a transitman in the chief engineer's office. On April 25, 1928, he was promoted to acting assistant supervisor on the W. & C. division, at Reading, Pa. On June 11, 1928, Mr. DeMoyer was appointed assistant supervisor, with office duties, on the Shamokin division, at Tamaqua, Pa., and on May 1, 1932, he was assigned to field work with the same title. Later he held this position at St. Nicholas, Pa., and at Pottsville, on the Shamokin division, and then went to West Trenton, N. J., on October 1, 1935. In 1937 Mr. DeMoyer was promoted to supervisor of track on the Philadelphia division, with headquarters at West Trenton, N. J., which position he held until his recent promotion.

Track

Clem Russell, general track formean on the Coast division of the Southern Pacific, has been promoted to roadmaster on the Tucson division.

T. J. Purdie has been appointed roadmaster on the Canadian Pacific, at Golden, B.C., succeeding **C. G. Johnson,** transferred.

C. A. W. T. Godden has been appointed roadmaster on the Candadian National, at Palmerston, Ont.

J. G. Walsh, roadmaster on the Canadian Pacific at Sherbrooke, Que., retired recently after 51 years of railway service.

I. M. Boone has been appointed acting roadmaster on the Atlantic Coast Line, at Goldsboro, N. C., succeeding **B. E. Thompson,** who has resigned.

G. M. Kinch has been appointed relieving roadmaster on the Canadian Pacific at Smiths Falls, Ont., succeeding **H. Gunning,** who has retired.

J. B. McKerley, assistant engineer on the Central of Georgia, has been promoted to track supervisor at Columbus, Ga., succeeding **Ralph E. Sease,** whose promotion to supervisor of bridges and buildings is reported elsewhere in these columns. Mr. McKerley entered the employ of the Central of Georgia on April 1, 1927, as a draftsman in the office of chief engineer, at Savannah, Ga. On September 1, 1928, he was advanced to assistant engineer.

L. J. Simons, assistant roadmaster on the Wisconsin division of the Chicago & North Western, has been promoted to roadmaster at Antigo, Wis., succeeding **A. Netzel,** who has been transferred to West Chicago, Ill., replacing **M. L. Bradbury,** assigned to other duties.

J. E. Emond, who has been on a leave of absence because of ill health, has returned to active duty as roadmaster on the Pecos division of the Atchison, Topeka & Santa Fe, at Clovis, N.M., succeeding **Frank E. Dauner,** who has been acting roadmaster during Mr. Emond's illness.

P. R. Matthews has been appointed assistant supervisor of track, Marion district of the Chesapeake & Ohio, at Marion, Ohio, succeeding **C. W. Butcher,** whose promotion to supervisor of track at Columbus, Ohio, was reported in the September issue. **G. P. Michael** has been appointed assistant supervisor of track, James River sub-division, at Clifton Forge, Va.

M. L. White has been appointed roadmaster of the Fifth track district of the St. Louis-San Francisco, at Springfield, Mo., succeeding **L. R. Johnson,** who has been transferred to the Sixth track district, with the same headquarters. Mr. Johnson replaces **O. L. Malone,** who has been transferred to the Second track division at Newburg, Mo., in place of **E. Swope,** who has been assigned to other duties.

B. S. Buskovick, assistant roadmaster of the Chicago, Rock Island & Pacific, at Rock Island, Ill., has been promoted to roadmaster at that point, succeeding **M. H. Bootjen,** who has been appointed roadmaster at Centerville, Ia., in charge new construction on a line revision there. **W. H. Berry,** track supervisor at Trenton, Mo., has been advanced to assistant roadmaster at Rock Island, relieving Mr. Buskovick.

D. B. Smith, assistant roadmaster on the Missouri Pacific, at Ferriday, La., has been promoted to acting roadmaster at Gurdon, Ark., succeeding **L. L. Wallis,** who has been transferred to North Little Rock, Ark. Mr. Wallis replaces **J. S. Smith,** who has been granted a leave of absence to serve with the U. S. Mission of Railways in Mexico. **A. W. Wood,** track foreman on the Louisiana division, has been advanced to acting assistant roadmaster at Ferriday, relieving **Mr. D. B. Smith.**

Theodore B. Thompson, whose promotion to supervisor of detector cars of the Illinois Central, at Carbondale, Ill., was reported in the July issue, was born on December 31, 1908, at Carbondale, and received his Master of Science Degree from the University of Illinois. He entered railway service as a signal helper on the St. Louis division of the Illinois Central in 1928, later serving as signal wireman and signal draftsman, until 1942, when he was advanced to chief operator, rail detector car.

J. Walter Cozzens, whose promotion to supervisor of track on the Monongahela division of the Pennsylvania, at Homestead, Pa., was reported in the July issue, entered the employ of the Pennsylvania in November, 1940, as an engineering apprentice on the Fort Wayne division. In January, 1941, he was promoted to assistant in the engineering corps on the Cincinnati division, serving subsequently on the Chicago Terminal division. In February, 1942, Mr. Cozzens was further advanced to assistant supervisor of track at Columbus, Ohio, and in April of that year he was transferred to the Maryland division, at Wilmington, Del., remaining in that location until his recent appointment.

J. G. Dail, whose promotion to roadmaster on the Atlantic Coast Line, with headquarters at Florence, S.C., was reported in the August issue, was born at Rocky Mount, N.C., on March 23, 1911. Mr. Dail entered railway service on November 1, 1929, as a section laborer on the Atlantic Coast Line, at Orangeburg, S.C., and two months later was promoted to apprentice foreman at that point. On March 15, 1930, he was appointed a helper in a division welding force, and on April 14, 1932, he was advanced to welding force foreman on the Northern division. In 1938, Mr. Dail was appointed material yard foreman at Florence, which position he held until his recent promotion.

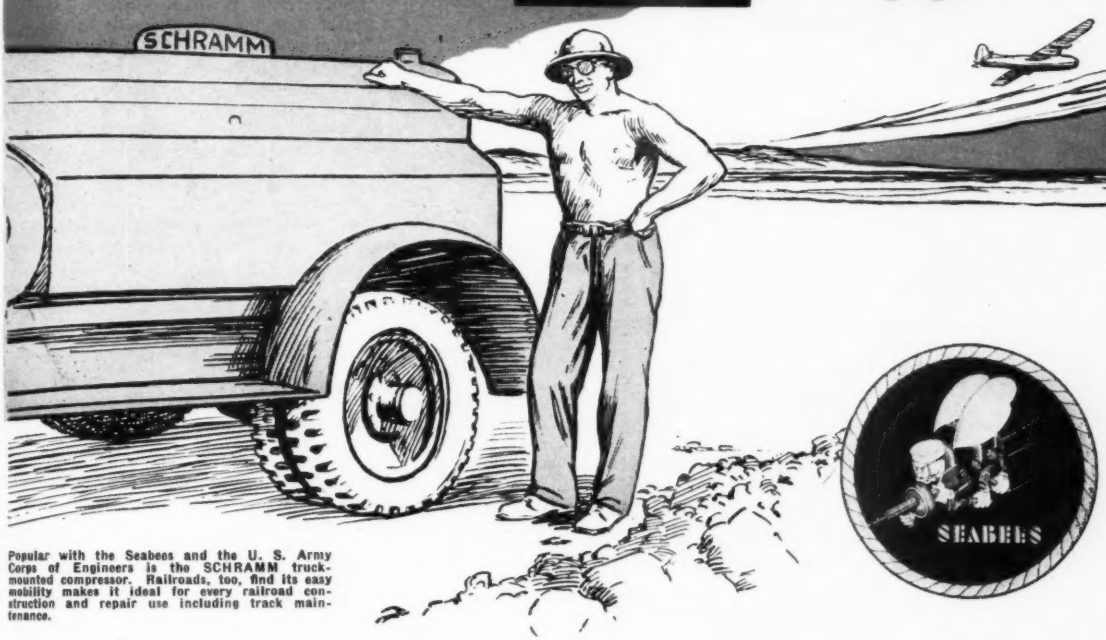
Samuel C. Jannotti, whose promotion to supervisor of track on the Pennsylvania, with headquarters at Emporium, Pa., was reported in the August issue, was born at Elizabeth, N.J., on February 11, 1914, and attended Union County junior college. He entered railway service on August 15, 1933, with the Pennsylvania, as a trackman at Manhattan Transfer, N.J. On December 20, 1934, he was advanced to assistant foreman at Newark, N.J., and on June 7, 1936, he was promoted to track foreman at Rahway, N.J., later being transferred successively to Newark, Elizabeth, Trenton, and Iselin, N.J. Mr. Jannotti was advanced to general foreman at Jersey City, N.J., on May 1, 1941, and five months later was promoted to assistant supervisor of track at Jersey City, which position he held until his recent promotion.

D. E. Cowell, whose promotion to supervisor of track of the Reading, with headquarters at West Trenton, N.J., was reported in the September issue, was born at Deerfield, Ill., on April 24, 1903, and was graduated in civil engineering from Bucknell University in 1927. He entered railway service in February, 1928, as a transitman in the office of the chief engineer of the Reading, at Philadelphia, Pa., and in January, 1939, was appointed general foreman at Philadelphia. Mr. Cowell was promoted to assistant supervisor of track at Tamaqua, Pa., in January, 1941, and a year later, was transferred to West Trenton. In August, 1943, he was appointed acting supervisor of track at Lansdale, Pa., which position he held until his recent appointment.

J. H. Ault, supervisor of track on the Columbus division of the Pennsylvania, with headquarters at Dayton, Ohio, has been transferred to Newport, Pa., on the Middle division, succeeding **W. C. Gretzinger,** whose promotion to assistant division engineer at Philadelphia is reported elsewhere in these columns. **A. E. Myles,** supervisor of track on the Indianapolis division at Columbus, Ind., has been transferred to Dayton, replacing Mr. Ault, and **Lloyd Wallace,** supervisor of track on the Indianapolis division at Spencer, Ind., has been transferred to Columbus (Ind.), relieving Mr. Myles. **R. G. Yates,** supervisor of track on the St. Louis division at Terre Haute, Ind., has been transferred to Spencer, succeeding Mr. Wallace, and **G. A. Godley,** supervisor of track on the Logansport division at Logansport, Ind., has been transferred to Terre Haute, replacing Mr. Yates. **J. L. Spinelli,** assistant supervisor of track on the Middle division, has been advanced to supervisor of track at Logansport, relieving Mr. Godley, and **W. C. Romig,** track foreman on

(Continued on page 1046)

"Man, this SCHRAMM is Really Rugged!"

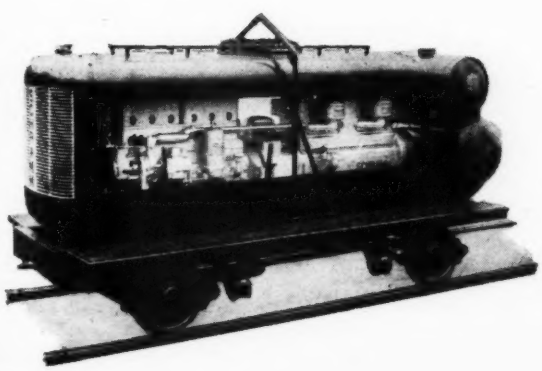


Popular with the Seabees and the U. S. Army Corps of Engineers is the SCHRAMM truck-mounted compressor. Railroads, too, find its easy mobility makes it ideal for every railroad construction and repair use including track maintenance.

"Seabees used equipment hard. We had to. Sometimes we couldn't be very careful with it, but this SCHRAMM compressor never let me down. Yes Sir! Back on my peacetime job I'll know I have something I can depend on whenever I meet a SCHRAMM compressor."

For the low-down on rough going ask the Seabees, who paved the way for successful invasions—and often did some of the fighting themselves. They will tell you that a compressor good enough to be in the Navy will handle any job, on the railroad or off. Fact is, you need not go all the way to the far Pacific to find that out, for SCHRAMMS are working on many of the difficult construction jobs right here in this country.

There are several SCHRAMM compressor models especially fitted for track maintenance. Learn about their exclusive quality features by sending for Circular RM 44. SCHRAMM, Inc., *The Compressor People,* West Chester, Pa.



SCHRAMM

AIR COMPRESSORS for RAILWAY MAINTENANCE

Wilkes-Barre division, has been promoted to assistant supervisor of track on the Middle division, succeeding Mr. Spinelli.

Bridge and Building

F. O. McGrew, assistant chief carpenter of the Iowa division of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to chief carpenter of the Terre Haute division, at Terre Haute, Ind., succeeding **F. E. Galvin,** who has been transferred to La Crosse, Wis., replacing **V. M. Hansen,** who has been assigned to other duties because of ill health.

W. H. Begeman, assistant bridge and building supervisor on the Missouri Pacific, at Falls City, Neb., has been promoted to supervisor, at Nevada, Mo., succeeding **G. H. Holmes,** assigned to other duties at his own request. **J. E. Wallace,** bridge and building foreman on the Illinois division has succeeded Mr. Begeman.

Donald H. Jenkins, whose appointment as supervisor of bridges and buildings of the Northern division of the St. Louis Southwestern, at Pine Bluff, Ark., was reported in the July issue, was born at Mount Vernon, Ill., on May 7, 1898, and received his higher education at Arkansas State College and at Washburn College. He entered the employ of the Cotton Belt in March, 1920, as a rodman on the Northern division, at Pine Bluff. He subsequently served as AFE checker, transitman, and senior transitman.

F. W. Young, general foreman of bridges and buildings on the Canadian National, at London, Ont., has been promoted to bridge and building master, with the same headquarters, succeeding **W. D. Graham,** who has retired. Mr. Young was born at Caledonia, Ont., and entered railway service in 1922 in a bridge gang on the Canadian National at Hamilton, Ont., later being promoted to foreman. In 1934 he was advanced to general foreman at Stratford, Ont., and in 1941 he was transferred to London.

Ralph E. Sease, track supervisor on the Central of Georgia, at Columbus, Ga., has been promoted to supervisor of bridges and buildings of the Savannah division, at Savannah, Ga., succeeding **Sam Youngblood,** who has retired after 44 years of service. Mr. Sease entered the employ of the Central of Georgia on November 1, 1928, as a draftsman in the engineering department. In June, 1935, he was advanced to assistant engineer in the valuation department, serving until December, 1939, when he was transferred to the track department. Mr. Sease was made track supervisor at Dotham, Ala., on April 16, 1941, transferring to Columbus in 1942.

Water Service

Walter R. Orange, whose promotion to supervisor of water supply of the Chesapeake & Ohio, with headquarters at Richmond, Va., was reported in the August issue, was born at Frederick Hall, Va., on May 20, 1900, and entered railway service on March 10, 1917, as a track laborer in the maintenance of way department of the Chesapeake & Ohio. On June 4, 1918, he was appointed a carpenter, and on March 15, 1928, he was appointed a tinner. Mr. Orange was promoted to carpenter foreman on January 1, 1931, and on March 1, 1932, he was appointed water supply foreman. He again became a carpenter foreman on September 1, 1935, and on August 19, 1939, was appointed a steel bridge foreman. Mr. Orange was appointed bridge inspector on December 8, 1943, which position he held until his recent promotion.

Obituary

W. A. Bercaw, who retired in 1942 as roadmaster on the Chicago, Burlington & Quincy, and who served for several years as district engineer maintenance of way at St. Louis, Mo., died at his home in Cameron, Mo., on September 19.

G. C. Palmer, roadmaster on the Chicago, Burlington & Quincy, at Kansas City, Mo., died in that city on August 24. Mr. Palmer, who was 61, had been with the Burlington for more than 45 years, having served as assistant section foreman, track foreman and roadmaster at Aurora, Ill., and Metropolis, and at St. Louis, Mo., Hannibal and Kansas City.

Marion Jay Parr, superintendent of the Savannah division of the Central of Georgia, whose recent death at Savannah, Ga., was reported in the August issue, entered railway service as a draftsman in the engineering department of the Central of Georgia in 1907, serving successively as assistant engineer, pilot engineer, supervisor of bridges and buildings and roadmaster. Upon his return from service in the engineer corps of the U. S. Army in 1919, he entered the operating department as an assistant trainmaster, advancing through various positions until October, 1925, when he was named a superintendent.

James A. Peabody, retired engineer maintenance of way of the Chicago & North Western whose death at Chicago, on July 10, was reported in the August issue, was born at Chicago on February 5, 1870, and commenced his railway career in June, 1888, as a rodman and instrumentman on the Baltimore & Ohio at Zanesville, Ohio. In 1892 he was appointed instrumentman on location, with headquarters at Pittsburgh, Pa., and in 1894 he left railway service to become chief draftsman of the Page Iron Works, Chicago. In 1898 he returned to railway service as a roadmaster on the North Western, in which position he served successively at Tracy, Minn., Ashland, Wis., and Milwaukee. In 1902 he was promoted to signal engineer with headquarters at Chicago, which position he held until 1931, when he was appointed to the position he held at the time of his retirement.

Henry H. Garrigues, retired assistant to the general manager of the Eastern region of the Pennsylvania, whose death at Radnor, Pa., on July 15, was reported in the August issue, was born at Harrisburg, Pa., on September 4, 1881, and attended Haverford School and Haverford College. He entered the service of the Pennsylvania on February 18, 1901, in the engineering department at Lambertville, N.J., and later was advanced successively to rodman, transitman, assistant supervisor of track and supervisor of track at various points. In December, 1917, he was promoted to division engineer of the Trenton division, later being transferred to the Philadelphia Terminal division. From May, 1920, to May, 1939, Mr. Garrigues served successively as superintendent of various divisions, and general superintendent successively at Chicago, Harrisburg and Williamsport, Pa. On the latter date he was advanced to engineer maintenance of way of the Eastern region at Philadelphia, and in October, 1940, he was granted a leave of absence because of illness. Mr. Garrigues returned to duty in July, 1941, as assistant to the general manager of the Eastern region.

Walter R. Parvin, chief engineer maintenance of way of the Eastern region of the Pennsylvania, whose death on July 28 was reported in the September issue, was born on March 15, 1892, at Wilkinsburg, Pa., and received the degree of B.S. in Civil Engineering from the University of Pitts-

Walter R. Parvin

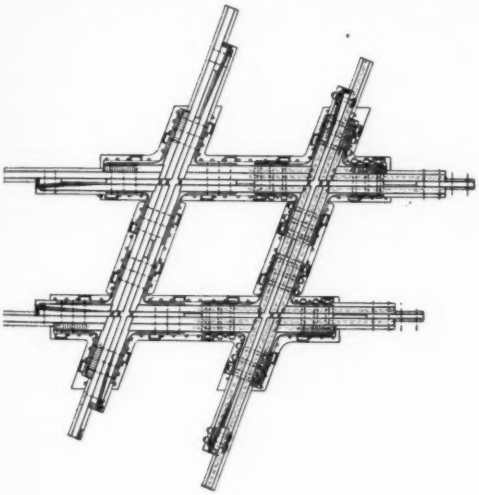
burgh in 1915. He entered railroading with the Pennsylvania in June, 1912, as a chainman, and after serving in the first World war, he returned to that road as assistant supervisor of track, being promoted subsequently to supervisor of track at Jersey City, N.J. Thereafter he held various engineering positions at Philadelphia and Pittsburgh, Pa., and at New York, until 1929, when he was promoted to division engineer of the Delmarva division at Cape Charles, Va. After transferring to Chicago in 1934 and to Altoona, Pa., in 1937, he served on the chief engineer's staff at Philadelphia from 1938 to 1940, when he was named engineer maintenance of way of the Southwestern division, at Indianapolis, Ind., On February 1, 1943, he was appointed chief engineer maintenance of way, Eastern region.

Schramm Air Compressors—Schramm, Inc., West Chester, Pa., has published a highly attractive and informative catalog which describes the complete line of Schramm stationary and portable air compressors. Designated as No. 45, the catalog illustrates each unit in its natural color and describes it in full, including the essential specifications of each model.

(Continued on page 1048)

MANY CROSSING TROUBLES SOLVED by the NEW...

Weir Kilby Heat-Treated Crossing



CATALOG "H"

Comprises 154 pages of helpful data, replete with photos, drawings and specifications, covers every track work need. A request on your letterhead will bring your copy promptly.

The search for better railroad crossings to meet present traffic demands, has led us to extensive research and analysis in the field of HEAT-TREATED RAIL CROSSINGS.

As designers and fabricators we have collaborated in research with one of the largest, best equipped and most capable heat-treating companies in the country. Their wide experience in heat-treatment of all kinds of steels insures a quality in our product excelled by none.

We find that some of the railroads, thinking along the same lines, and after exhaustive trial of HEAT-TREATED RAIL CROSSINGS, have found them so satisfactory that they are now using them to the exclusion of all other types when the density of traffic and speed require the best and most durable construction.

Our method consists of fabricating and completely assembling all the parts in carbon steel rail; after all adjustments have been made to insure proper fit of all the parts, the crossing is taken apart and sent to the steel treating plant, where each rail is individually heat-treated and tested before final assembly. We suggest your consideration of the New Weir Kilby Heat-Treated Crossings for your next requirement.

Standard and Special Track Work for Steam Railroads Since 1882

WEIR KILBY CORPORATION

CINCINNATI 12, OHIO — **BIRMINGHAM 7, ALA.**

Successors to

WEIR FROG CO. . . . KILBY FROG & SWITCH CO. . . . CINCINNATI FROG & SWITCH CO.

Association News

Convention Ban Off

The ban on conventions, group meetings and trade shows was removed on October 1, Col. J. Monroe Johnson, director of the Office of Defense Transportation, has announced. The removal of the convention ban is expected to clear the way for numerous railway conventions which were not held during the war, including those of the American Railway Engineering Association, the Roadmasters' Association, the Bridge and Building Association and the Wood Preservers' Association.

Railway Tie Association

The twenty-eighth annual convention of the association will be held in the Netherland Plaza Hotel, Cincinnati, Ohio, on May 7-8, 1946.

Roadmasters' Association

The association held a restricted one-day annual meeting in Chicago on September 12, at the Hotel Stevens, with an attendance of approximately 75. A detailed report of the activities at this meeting, together with all five technical reports presented and acted upon at this meeting, are presented elsewhere in this issue.

Metropolitan Maintenance of Way Club

The next meeting of the club will be held in Governor room of the Hotel Governor Clinton, New York, on Thursday, October 25. This will be an evening meeting with dinner at 6:30 p.m. Arrangements are being made, but have not been completed, for an interesting address to feature the program.

A.R.E.A. Plans Annual Meeting

With the lifting of the ban on conventions by the office of Defense Transportation, effective October 1, the American Railway Engineering Association is making tentative plans to resume its war-time-deferred annual meetings, looking to a meeting to be held at the Palmer House, Chicago, on March 12, 13 and 14, 1946. The National Railway Appliances Association, which in peace-times has conducted an exhibit of equipment and other products of interest to engineering and maintenance officers in conjunction with the A.R.E.A. annual meetings, has, as yet, made no plans for an exhibit in March, but its president, W. J. Hanna, has called a meeting of the board of directors on October 5, to consider the resumption of annual exhibits.

Maintenance of Way Club of Chicago

The first fall meeting of the club will be held on Monday, October 22, in the Ambassador Room of Hyler's Restaurant, the Strauss Building 310 S. Michigan Ave., Chicago. Dinner will be served at 6:30 p.m., following which the meeting will be addressed by Col. John W. Wheeler, executive assistant of the Chicago, Burlington & Quincy, and until recently chief engineer of the 16th Corps, United States Army, serving with the invasion forces in France, Belgium, Holland and Germany. Col. Wheeler will address the group on German Railways on V-E Day, and will accompany his talk with lantern slides of railway damage and reconstruction during the invasion.

American Railway Engineering Association

To date five committees have scheduled meetings to be held in October, these being the Committee on Maintenance of Way Work Equipment, which will meet at Chicago on October 9; the Committee on Co-Operative Relations with Universities, which will meet at Chicago on October 16; the Committee on Water Service, Fire Protection and Sanitation, which will also meet at Chicago on the 16th; the Committee on Masonry, which will meet at Detroit, Mich., on October 17 and 18; and the Committee on Rail, which will meet at Chicago on October 24.

During September, meetings were held by five committees, including that on Roadway and Ballast, which met at Chicago on September 18 and 19; the Committee on Track, which met at Chicago on September 13; the Committee on Yards and Terminals, which met at Cleveland, Ohio, on September 25; and the Committees on Economics of Railway Location and Operation and Economics of Railway Labor, both of which met at Chicago on September 26.

During October the September-October Bulletin will be mailed to members. This will include one research report, one monograph and other material.

Bridge and Building Association

The association will hold a one-day annual meeting in the Hotel Stevens, Chicago, on October 17, restricted in scope from the usual three-day annual meeting, but which, with the ban on such meetings lifted by the O.D.T., will be open to all members and other railway men who desire to attend. The principal business of the meeting, which will begin at 9:30 a.m., will be the presentation, discussion of and passing upon eight technical committee reports prepared during the year, the election of officers, and the organization of the work of the association for the ensuing year.

The reports to be considered at the meeting are as follows: The Use of Highway Trucks in Bridge and Building Work; The Elimination of Fire Hazards and the Maintenance of Fire-Protective Equipment; The Maintenance of Wood Bridges and Trestles; Economical Methods for the Maintenance of Impounding Reservoirs; New Developments in Interior Painting; The Influence of Maintenance Practices on the Development of Modern Enginehouses; Piles, Pile Driving and Exploration; and Restoring Old Masonry by Grouting, Including Surface Treatment Where Necessary.

In preparation for the annual meeting, the Executive committee of the association will meet in the rooms of President J. L. Varker at the Hotel Stevens, at 4:00 p.m., October 16. All committee chairmen, as well as officers and directors of the association are invited to attend this meeting.

Supply Trade News

General

Johns-Manville Corporation, New York, has announced the construction of a new research center, consisting of six buildings to be located near Bound Brook, N.J.

The Butler Manufacturing Company, Kansas City, Mo., has acquired all patent and manufacturing rights of the Steel Building division of the Globe-Wernicke Company, and will add the features of the Globe-Wernicke buildings to its own designs. Quantity production on a new line of steel buildings will start soon.

Personal

Lewis A. Harlow, assistant manager, has been appointed manager of the advertising division, **Fairbanks, Morse & Co.**

C. L. Owens, assistant general sales manager, has been appointed general sales manager of the **Philip Carey Manufacturing Co.,** Cincinnati, Ohio.

Walter W. Fischer, manager of the war contracts division of **R. G. LeTourneau, Inc.,** Peoria, Ill., has been promoted to assistant to the general sales manager.

John S. King, manager of the pump division of **Fairbanks, Morse & Co.,** has been appointed acting manager of the Railway Sales division, succeeding **Charles H. Wilson,** whose death on September 13, is reported elsewhere in this issue. **Arnold G. Brown,** assistant manager, has been promoted to manager of the pump division, replacing Mr. King.

Thomas F. Tough has been appointed president of the **E. C. Poehler Company, Inc.,** Chicago, manufacturer's agents for railway supplies and equipment, to succeed **Edward C. Poehler,** whose death is noted elsewhere in these columns. Mr. Tough was formerly associated with Crerar, Adams & Co., and the H. Channon Co.

F. D. Haberkorn, assistant sales manager of the Central division of the **Caterpillar Tractor Company,** at Peoria, Ill., has been promoted to manager of the sales training division, with the same headquarters. **J. W. Mohler,** district representative in the Dallas, Tex., and New Mexico territory, has been advanced to assistant sales manager of the Central division, succeeding Mr. Haberkorn.

Paul Dickinson, Inc., Chicago has been acquired by **J. B.** and **J. J. Hank,** heads of both the Conlon Corp. and the Montgomery Elevator Co., Chicago and Moline, Ill., and its name has been changed to **Paul Dickinson Company.** J. J. Hank is vice-president and operating manager of the new company and **Arthur J. Filkins,** former head of Paul Dickinson, Inc., remains as consulting manager.

Arthur T. Stanton has been appointed general sales director of the **Master Vibrator Company,** Dayton, Ohio. In his new position he will have supervision

(Continued on page 1050)

Busy Tracks-
Heavy Loads-
High Speeds-

your track crews need DUFF-NORTON jacks

Remember—when buying tools for today's needs, you want them to be good tools . . . equipment that will give you top-flight performance throughout the years ahead.

So be sure that your track crews are supplied with Duff-Norton Track Jacks. They're ruggedly built to stand up under the toughest kind of service. There's a Duff-Norton Track Jack for every job. Catalog on request.

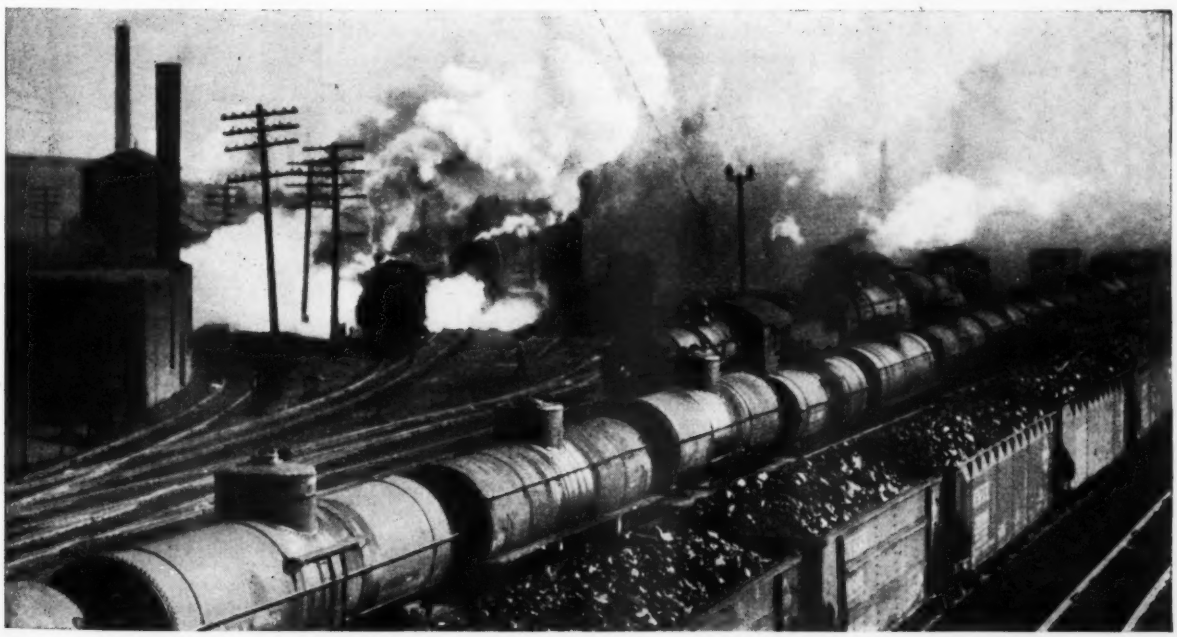
To repair the damage and wear caused by the terrific pounding of today's heavy, continuous traffic, your track crews need the very best, most dependable equipment.

Duff-Norton Track Jacks are living up to their standards of dependability, safety and efficiency—mechanical muscles to speed track maintenance work!

Why you should specify DUFF-NORTON Track Jacks

Every Duff-Norton Track Jack is husky, powerful, easy to spot and simple to operate . . . made by the world's oldest and largest manufacturer of lifting jacks especially for railroad track service . . . carefully inspected and tested . . . built to give you satisfactory service.

The Duff-Norton Manufacturing Company · Pittsburgh, Pa. · Canadian Plant: COATICOOK, QUE. Representatives in Principal Cities



over all domestic and export sales, sales promotion, merchandising and advertising. Mr. Stanton, who is a mechanical and industrial engineer, was formerly director of sales of the Chrysler Corporation and later an official of Willys-Overland. For the last four years he has been with the government in Washington, first

Arthur T. Stanton

as one of the organizers of the Division of Contract Distribution, and recently as chief of operations of the Production Facilities Bureau of the War Production Board.

John S. Hutchins, executive vice-president of the **Ramapo Ajax Division** of American Brake Shoe Company, has been elected president of the Division, succeeding **J. Brookes Spencer,** who remains a vice-president of the Brake Shoe Company. Mr. Spencer will handle special assignments in connection with railroad sales for all divisions in addition to his duties as officer in charge of the export division. Mr. Hutchins entered the em-

John S. Hutchins

ploy of Ramapo Ajax in 1925, in the operating department. He was appointed sales manager in 1941, and in October, 1944, he was elected executive vice-president. A more complete sketch of Mr. Hutchins' career appeared in the November, 1944, issue.

Kenneth Cavins, district manager of **Fairmont Railway Motors, Inc.,** Chicago, has been appointed manager district sales, with headquarters in Chicago and Fairmont, Minn. **W. D. Brooks,** district manager at Fairmont, has been appointed also manager export sales, with the same headquarters. **Harmon Sly,** district manager at New York, has been transferred to Chicago, succeeding Mr. Cavins. **W. H. Ripken,** representative, New York distirct, has been appointed district manager at New York, replacing Mr. Sly.

Frank R. Wood has been elected president of the **P. & M. Company Limited,** Montreal, Que., with headquarters in Montreal. **Walter F. Wood,** who has been on military leave of absence to serve as a Captain in the Canadian Infantry Corps, has been appointed secretary, with headquarters also in Montreal. Frank R. Wood entered the employ of the Rail Joint Company, a subsidiary of the P. & M. Company, in its London, England, office in 1907, serving that company for two years. After a period of employment with other companies, he served in the British Army during World War I, com-

Frank R. Wood

ing to Canada at the close of that war to serve as secretary to the superintendent of the Canadian Pacific, at Moose Jaw, Sask. In 1922 he went with the Railway Age as secretary to the editor. He joined the P. & M. Company, Limited, in Montreal, in 1925, holding various positions with that concern until his recent election.

Obituary

Norbert T. Jacobs, manager of sales of the Wood Shovel and Tool Company, died of a heart attack in Piqua Memorial Hospital, Piqua, Ohio, on August 20.

George L. Walters, who for the last ten years has served as southwestern district field engineer, at Ft. Worth, Tex., of the Electric Tamper & Equipment Co., died on August 16.

Edward C. Poehler, president of the E. C. Poehler Company, Inc., Chicago, died on August 4 at his home in that city. Mr. Poehler had been active in railway and industrial circles for the last 40 years and was formerly president of Crerar, Adams & Co., Chicago.

Charles H. Wilson, manager of the railroad sales division of Fairbanks, Morse & Co., died suddenly in Mercy Hospital, Chicago, on September 13. Mr. Wilson was born in Salem, Mass., on May 27, 1884, and received his higher education at the Armour Institute of Technology. He entered the sales department of Fairbanks, Morse in 1905, at Chicago. In 1910 he was transferred to Jacksonville, Fla., remaining there until 1911, when he returned to Chicago as a member of the staff of the purchasing department. The following year he went with the International Harvester Company, handling sales

Charles H. Wilson

in northern Illinois, returning to Fairbanks, Morse in 1913, in the railway sales department, at St. Louis, Mo. He was transferred to Chicago in 1922, and in 1929 he became district manager of railroad sales at St. Louis. Mr. Wilson was promoted to manager of railroad sales, with headquarters at Chicago, in 1932, holding this position until his death.

John W. Murphy, manager of sales, rails and accessories, of the Bethlehem Steel Company, whose death at Bethlehem, Pa., on June 24, was reported in the August issue, was a graduate of Massachusetts State College, and had studied subsequently at Temple Univer-

John W. Murphy

sity and Trinity College, Dublin, Ireland. In 1919 he went with the Midvale Ordnance Company in their Boston office, and when that company was absorbed by Bethlehem Steel Company in 1923 he entered the employ of the latter company. In 1927 he was transferred to Baltimore, Md., and in January, 1943, he was named acting manager of sales, rails and accessories, at Bethlehem. In September of that year he was further advanced to manager of sales, rails and accessories.

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Prevents corrosion of the rail joint

Eliminates principal cause of frozen joints

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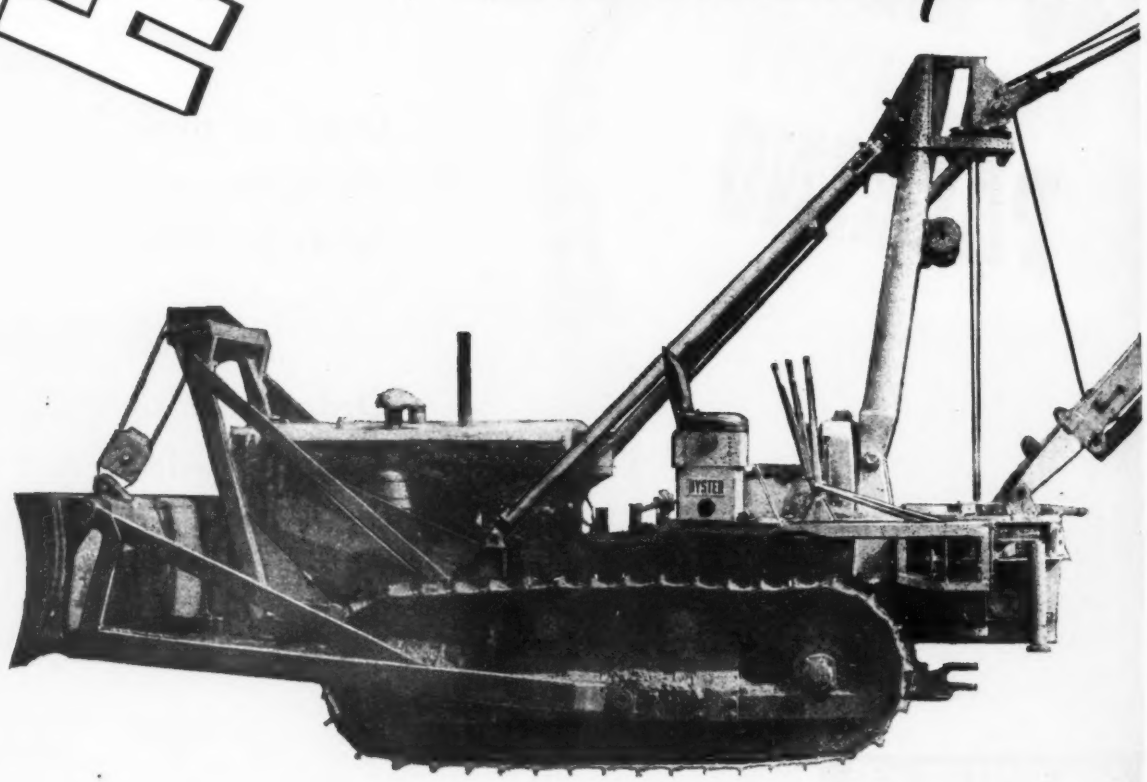

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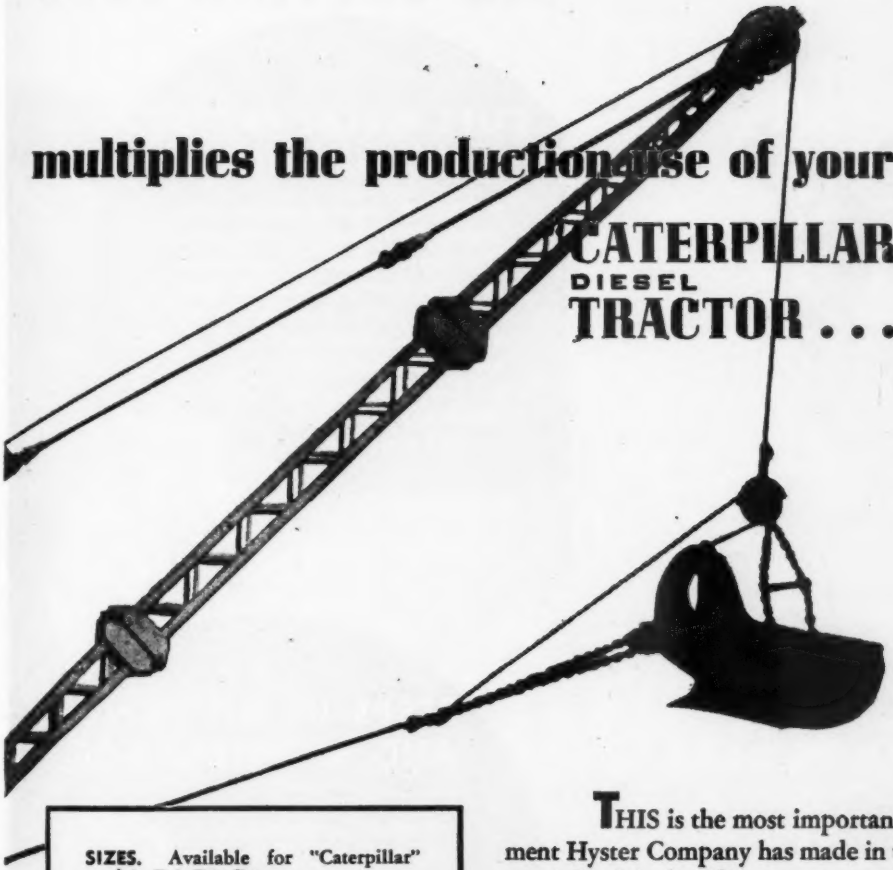

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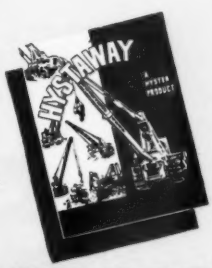

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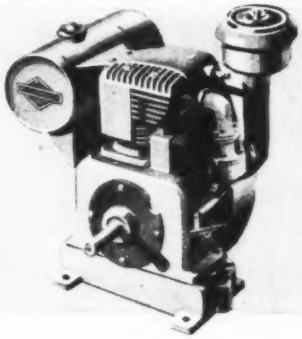

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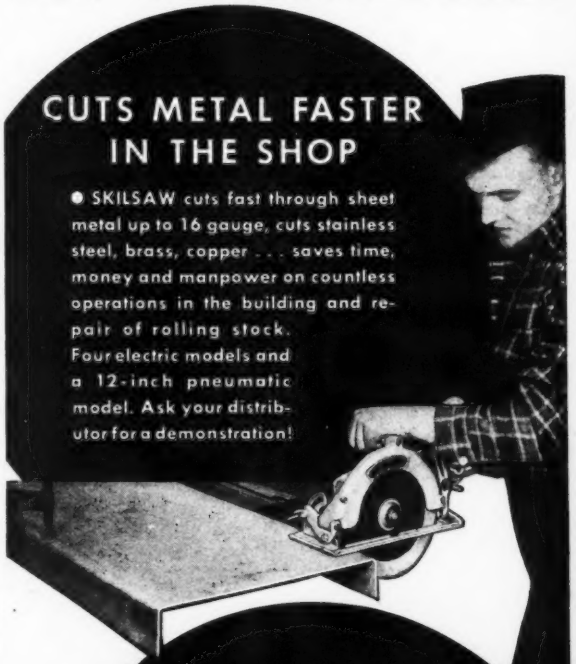

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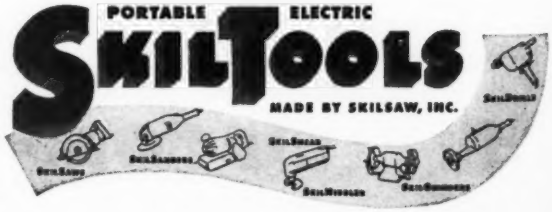

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Monotubes are light in weight for fast, easy, economical handling under all conditions. Available in gauge, size and taper to meet varying requirements.

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How Airco Processes Aid

UNDER the stress of severe wartime conditions, railroad maintenance men have placed greater reliance than ever on Airco time-proven oxyacetylene flame and electric arc methods. These processes are giving valuable aid both in restoring battered rail ends, worn frogs and switch points and in reconditioning maintenance tools and work equipment.

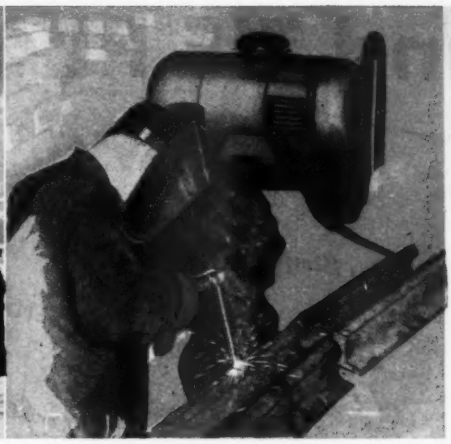
Airco's Applied Engineering Department will be glad to assist maintenance engineers on any problem involving the use of these and other Airco processes. For additional infor-

call or write your nearest Airco office.

Building Up Worn Rail Ends . . . Long a standard method on many railroads, this economical oxyacetylene flame process is today proving doubly helpful in easing the problem caused by the scarcity of replacement rails.

AIRCO

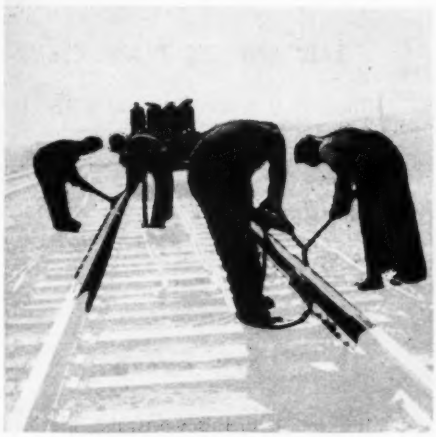
Maintenance Operations



Welding Fractured Angle Bars . . . This is one of many Airco methods for repairing irreplaceable materials. The fractured area in the bar is first cut out with an oxyacetylene torch. Then the bar is welded with Airco No. 93 Electrode. The bars are next reformed into head free bars and heat treated.

Building Up Worn Frogs . . . This economical method of building up worn frog points and wing rails is used more widely today than ever before. It not only renews the life of worn frogs, but it reduces traffic interruption to a minimum.

Rail Cropping . . . Rail ends are cropped quickly and neatly by this Airco-developed portable rail cropping machine.



End Hardening New Rails . . . New main line open hearth rails are end hardened in the field to prevent rail end batter. In this method, the rail ends are heated to about 1500° F. by oxyacetylene flame torches, quenched and then drawn to secure proper hardness.

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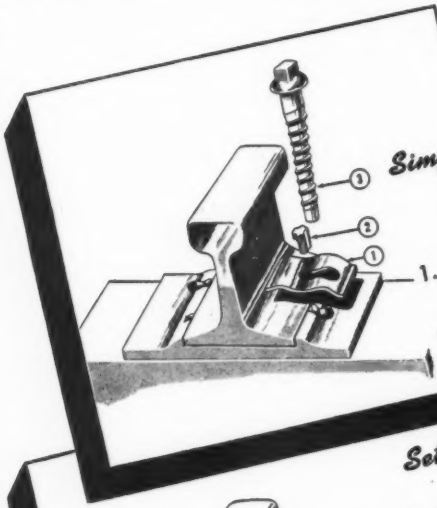
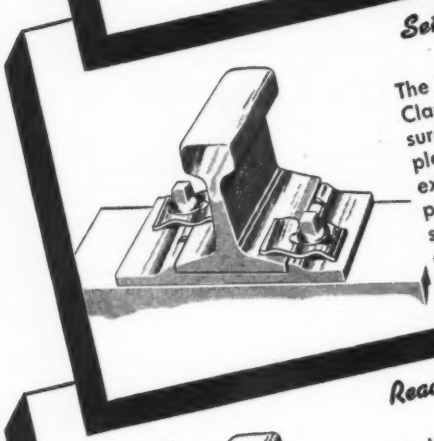
The Thompson RAIL and TIE PLATE CLAMP with RAIL GUARD



Simplicity of Assembly

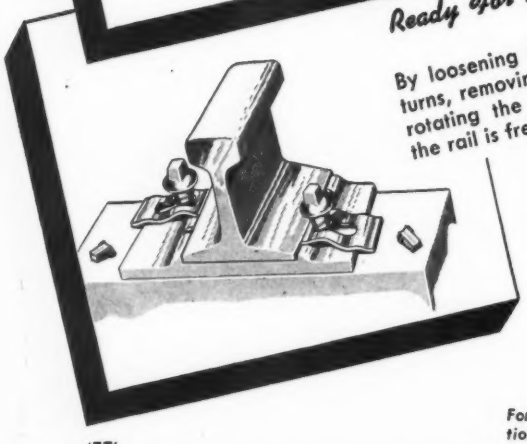
Requires no special Tools

1. THOMPSON RAIL AND TIE PLATE CLAMP.
2. RAIL GUARD.
3. STANDARD SCREW SPIKE.



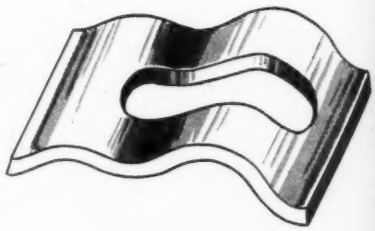
Set In Working Position

The Thompson Rail and Tie Plate Clamp maintains a resilient pressure that holds the rail firmly in place, reduces the effect of rail expansion and contraction, and provides the required frictional resistance between the rail, tie plate and tie. Employing a screw spike eliminates all cut spikes, costly over spiking and tie splitting.



Ready For Removal of Rail

By loosening the screw spike two turns, removing the rail guard and rotating the clamp 180 degrees, the rail is free for removal.



RAIL AND TIE PLATE CLAMP

The unit is made of sturdy 3/16" carbon spring steel, and is treated with a rust inhibitor to assure long, efficient service.

RAIL GUARD

The rail guard governs the specified anchoring pressure that is to be exerted by the clamp on the rail and tie plate.

The rail guard also serves as a safety device in preventing the clamp from being stressed beyond its elastic limit, and also in holding the rail in position in the event the clamp is damaged from any cause.

For a practical demonstration and further information on Thompson Rail and Tie Plate Clamps write:

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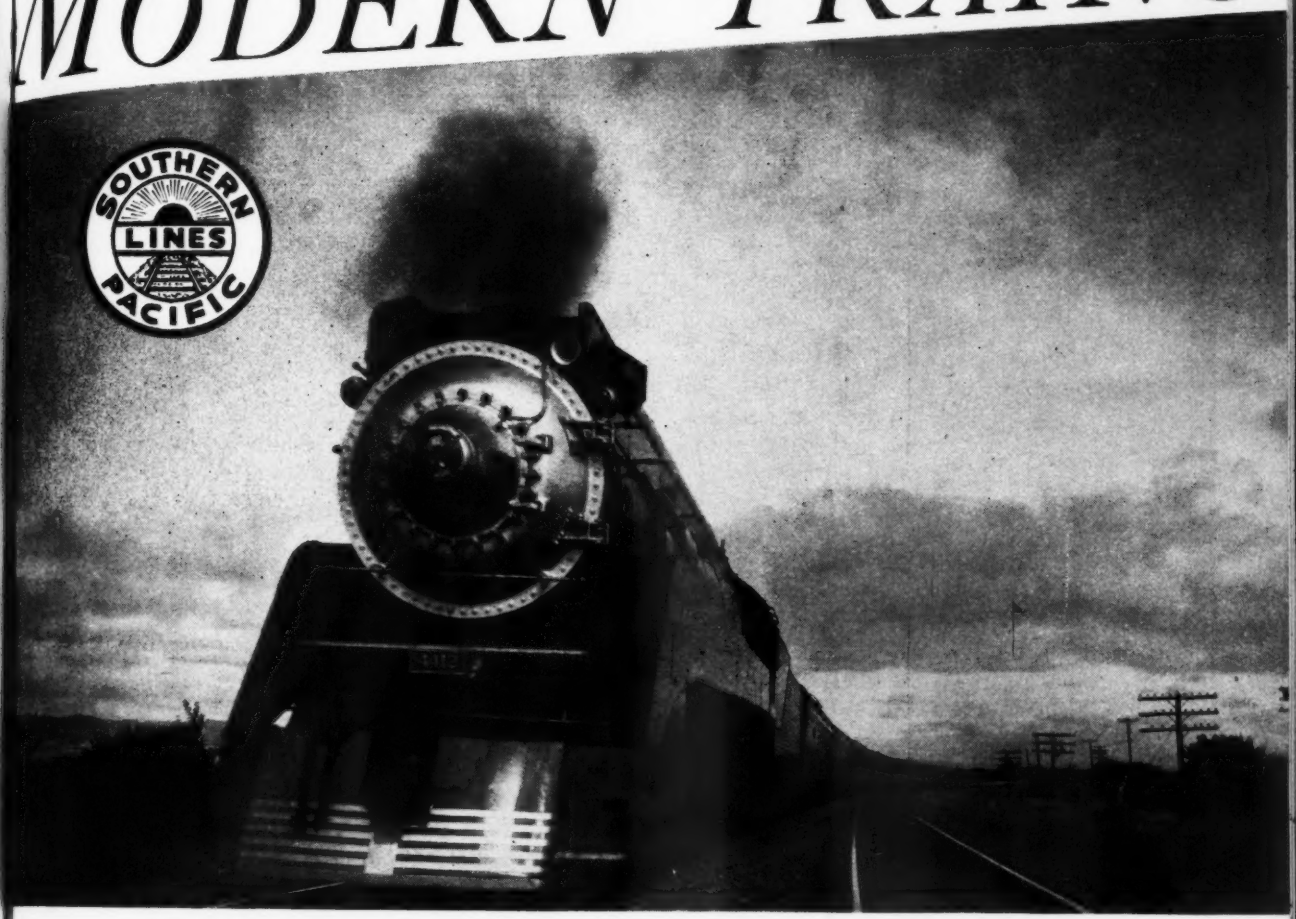
MODERN TRAINS



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BY C. M. KURTZ

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Accepted Definitions of General Track Terms—Design of Split Switches—Design of Frogs—Design of Movable Point Crossings and Slip Switches—Design of Crossings—Design of Split Switch Turnout Layouts—Turnouts in Paved Streets—Turnout Engineering—Turnouts Connecting With Divergent Tangents—Connecting Tracks—Wye Tracks—Siding Connections—Crossovers—Yard Layouts—Crossing Layouts—Solution by Traverse—Vertical Curves—Easement Curves and Superelevation—Tables—Index. 1945. 3rd Ed. 460 pages, 117 drawings, 34 tables.

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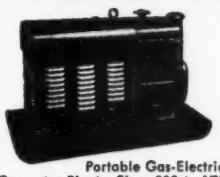

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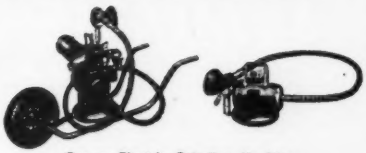

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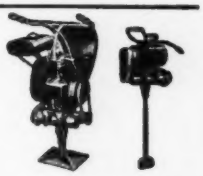

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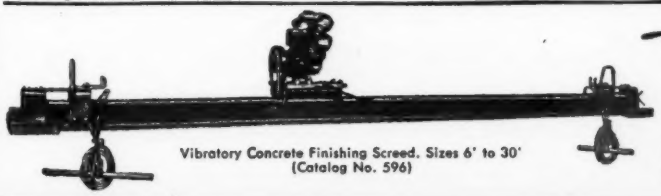

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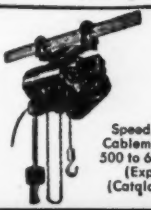

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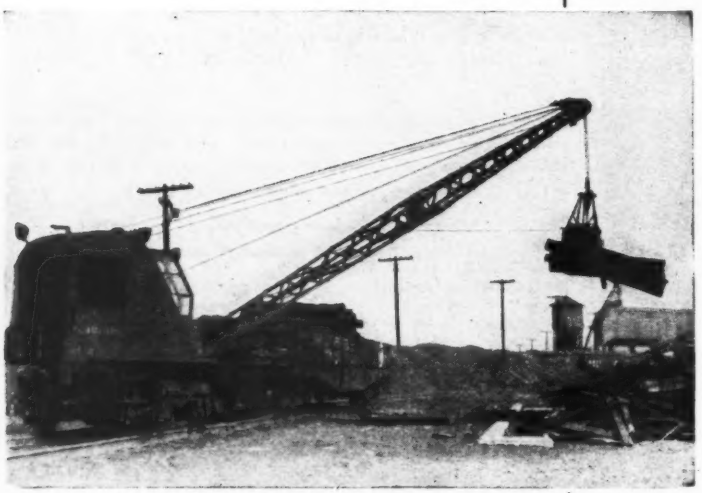

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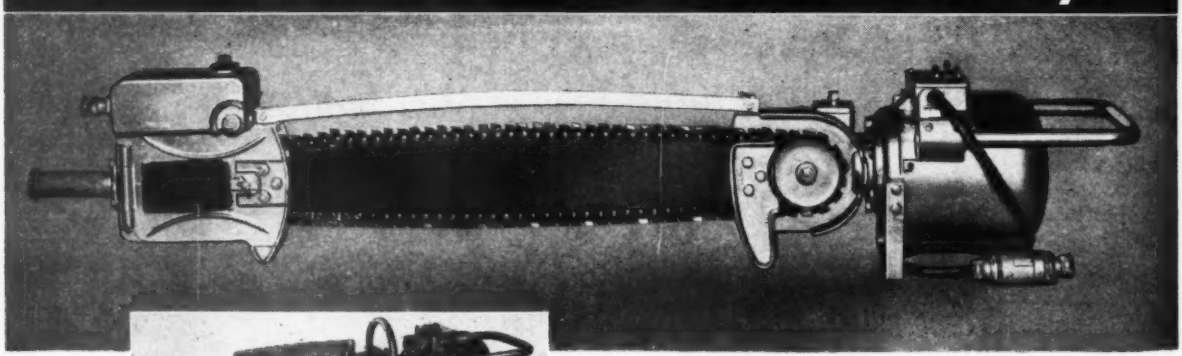

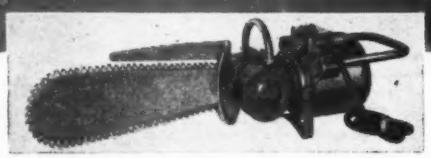

One man Portable TIMBERHOG SAW — same sturdy construction — 1½ HP Universal electric motor, 110 AC or DC, 20" capacity — weight 54 lbs. Priority required.

Portable two-man electric motor drive

TIMBERHOG SAW

suited for general timber cutting in construction, railroad, mine, shipyard or plant maintenance — 1½ HP Universal electric motor, 115 v. DC or 110 v. AC, 24" capacity, weight 65 lbs. Easily transported—a useful tool for construction operations. Priority required.

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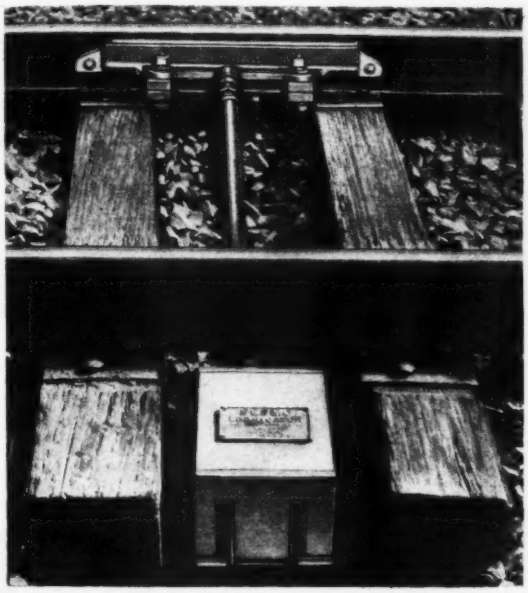
REED-PRENTICE CORP.
WORCESTER SAWS MASS., U.S.A.

"ORIGINAL and LARGEST manufacturers of portable timber saws—since 1927."

WORCESTER MASSACHUSETTS

SAVE STEEL *with* ARDCO

Rail and Flange Lubricators



Sesmo Automatic Rail and Flange Lubricator

AUTOMATIC oiling of rails and wheel flanges reduces friction—cuts down maintenance costs—increases tonnage capacity and permissive speed over curved track.

The "Sesmo" type lubricator shown above is the culmination of Ardco's long experience in the railroad field.

Properly located, these lubricators will pay for themselves many times over in less frequent replacement of curve rails—less tire turning—increased safety.

● EXAMINE THESE "SESMO" FEATURES

- Force feed action actuated by wave motion of rail.
- Positive lubricant pick-up. No waste.
- Auxiliary piston prevents excess lubricant accumulation on side of rail.
- Discharge assembly does not contact wheel flanges.
- No projecting parts to cause damage to lubricator or injury to employees.

ARDCO MANUFACTURING COMPANY
1116-1118 Paterson Plank Road N. Bergen, N. J.

PUZZLE:

HOW TO PLACE MORE CONCRETE WITH LESS LABOR . . . WITHOUT DELAYING TRAFFIC?

A big order? Not with Rex Pumpcrete . . . the pump that pumps concrete through a pipe line! It's the modern, practical method that takes concrete placement out of the "lift and carry" class and makes it a simple pump and pipe-line operation.

For instance—the illustration shows a Pumpcrete and Rex 14S Mixer in action on the Norfolk & Western Railroad. Here the old masonry of two main bridge piers was encased in concrete. Rex Pumpcrete and Mixers were installed on existing spur track *450 linear feet* from the construction! Time and money were saved in the elimination of expensive preparatory work that would have been required with any other concrete placing system. What's more, the work was carried on without interference to normal rail traffic.

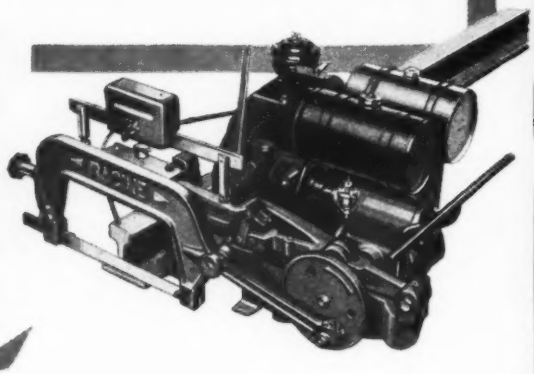
You'll find Rex Pumpcrete in use by many railroads, including the New York Central; Baltimore and Ohio; Chicago, Milwaukee & St. Paul; Norfolk & Western; Denver & Salt Lake; and many others. They use Pumpcrete because it's faster and more economical. The mixing is done off the right-of-way and the concrete is transported, elevated and placed in *one* operation—by pumping through pipe line.

For complete information on Pumpcrete, send for copy of Bulletin No. 464, Chain Belt Company, 1601 W. Bruce Street, Milwaukee 4, Wis.

REX CHAIN BELT COMPANY

CONSTRUCTION MACHINERY

A RACINE *Portable* RAIL CUTTER will do the job



Faster... More Accurately... *with* Less Help... *at* Lower Cost

Use the RACINE Portable Rail Cutter for cropping rail when closing track, fitting new rail at turnouts, crossovers, derails and crossings.

This portable machine is easily transferred from one job to another. Prominent roads everywhere use it extensively for frog and switch work, at interlocking plants, reclamation plants and in terminals.

Two men can carry the machine. One man operates it. Cuts fast, smooth and accurately. Sawing the rail eliminates tiny fractures that may lead to rail failure.

The standard machine will cut rail 7⅜" high by 6¾" wide; extra capacity model will handle rail 10" high by 6¾" wide. Both machines available with gasoline engine, electric or air motors.

Our Bulletin 58-A contains full details. Ask for your free copy today.

RACINE'S metal cutting saw line is complete

The RACINE line of saws includes models for high speed production and general shop work. Capacities 6" x 6" to 20" x 20" in all price ranges. Every model is equipped with the simplest and latest operating devices for the accurate cutting of any metal from soft aluminum tubing to hard alloy tool steels. Ask for Catalog No. 12. Racine Tool and Machine Company, 1738 State Street, Racine, Wisconsin, U. S. A.

RACINE

Here it is! *The New* JUSTRITE RAILROAD HEAD-LANTERN

Designed for Oilers and Packers

Specially designed bulb housing can be attached around the head, on the wrist, on the knee or around the shoulder to throw light from any position and to any direction. Powerful beam can be focused directly where required.

Strong, durable construction for heavy duty service. Uses standard 6-volt railroad battery and standard bulb.

Shoulder and belt straps hold battery case in easy, comfortable position for carrying. Both hands are free to speed-up maintenance service. Here's a new Head-Lantern for railroading that's...Justrite.

Ask your Supplier for complete details

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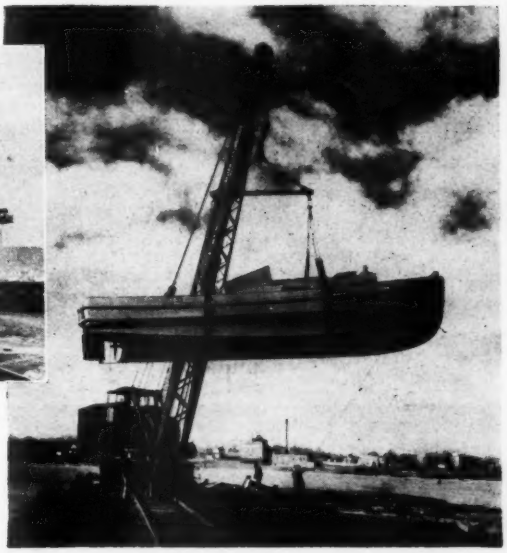
SAFETY CANS · FILLING CANS · OILY WASTE CANS
APPROVED SAFETY ELECTRIC LANTERNS

on the waterfront—or inland—I. B. equipment is doing a top-notch job of material handling

From Atlantic docks to Pacific ports, and at practically every major industrial point in between, industrial Brownhoist Cranes, car dumpers, and coal and ore bridges are speeding production schedules—slashing man hours—with their swift, economical handling of heavy, bulky materials. No matter where or what your material handling problems are —get the facts first from I.B.

Below left: I.B. 17-20 Ton Traveling Ore Bridge with 344 ft. bridge span and raisable apron extending 114 ft. from pier leg center line on dock side. Below: This I. B. 40-Ton Diesel Locomotive Crane easily swings an army craft from water to flat car after trial run. Patented Monitor type cab allows operator 360° visibility.



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Photos courtesy Santa Fe, B & O, Southern & Seaboard Railways

JACKET COOLING WATER PROBLEMS

respond to

HAERING GLUCOSATES

WE READ WATER

Write for "H-O-H Lighthouse," containing articles on Diesel Engine Cooling Water Treatment for Scale and Corrosion Control.

D. W. HAERING & CO., Inc.

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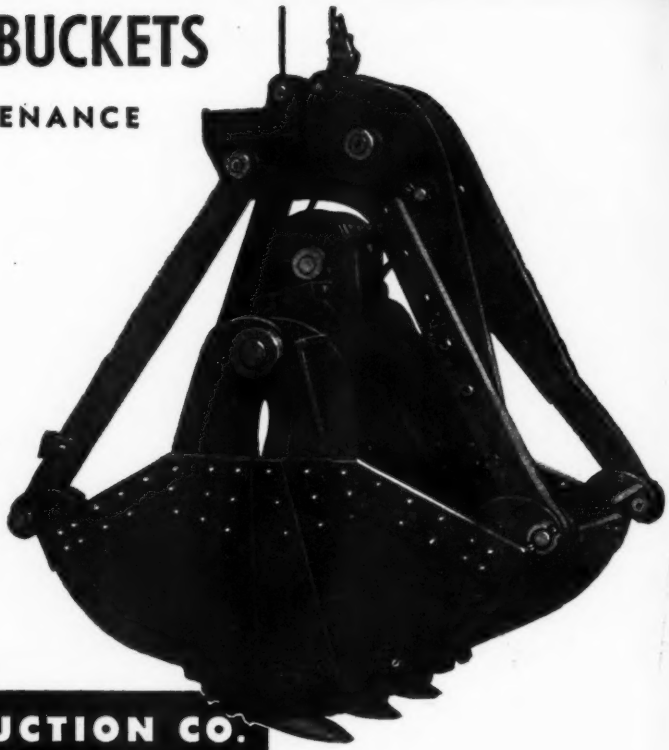
205 West Wacker Drive, Chicago 6, Ill.

ERIE *Multi-Power* BUCKETS

GOOD FOR RAILWAY MAINTENANCE



Your road will be interested in this sturdy 2-line Erie Clamshell Bucket, for it was selected by the U.S. Army and Navy and used by the Thousands on all fighting fronts. It's a compact, powerful design that digs in for a capacity load at every bite. Selective reeving 2, 3, or 4 parts provides bucket service in all kinds of materials. We have prepared an operation manual that describes this bucket and illustrates it in every detail.

Write for copy today, for it answers every question about this bucket. Address: Erie Steel Construction Company, 11511 Geist Road, Erie, Pennsylvania.

ERIE STEEL CONSTRUCTION CO.
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TIE PLATES

Use Lundie Tie Plates

Requiring 10% Less Steel to Manufacture

MORE than 250,000,000 Lundie Tie Plates placed in service by the railroads is an outstanding recognition that the inclined, stepped seating without tie cutting projections, essentially smooth bottom, will hold the track to gauge eliminating the use of additional spikes such as is required with flat bottom plates. These important features coupled with the fact that Lundie Tie Plates require 10% less steel to manufacture more than justifies their use for conserving critical material for the duration.

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THE TRACK SUPPLY ASSOCIATION TSA

Manufactured to A. R. E. A. Specifications **Furnished in Double or Single Shoulder**

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Tie Plates—Spring Rail Clips—Safety Tongs for Handling Track Material—Aladdin Rail and Flange Lubricator

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Investigate
BLACKMER ROTARY PUMPS
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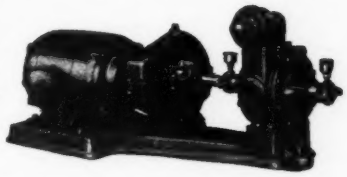
"Bucket Design" swinging vanes automatically compensate for wear. When the "buckets" finally wear out, a 20-minute replacement job restores the pump to normal capacity.



Write for Bulletin No. 306—Facts About Rotary Pumps
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FOR AMERICA'S RAILROADS

Water is of tremendous importance to railroads! A shortage—or failure of water supply can play havoc with schedules. Maintenance engineers on practically all of America's major railroads have long insisted on—and use Layne Well Water Systems. These experienced men can—and do place absolute confidence in Wells and Pumps Built by Layne. No other kind has yet won their full approval.

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Layne Well Water Systems are serving all types of industry—thousands of cities, irrigation projects and the world's largest mines—not only the United States, but in practically every foreign country on the globe.

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Layne Vertical Turbine Pumps are now available in sizes to produce from 40 to 16,000 gallons of water per minute. Their high efficiency saves hundreds of dollars on power cost per year.

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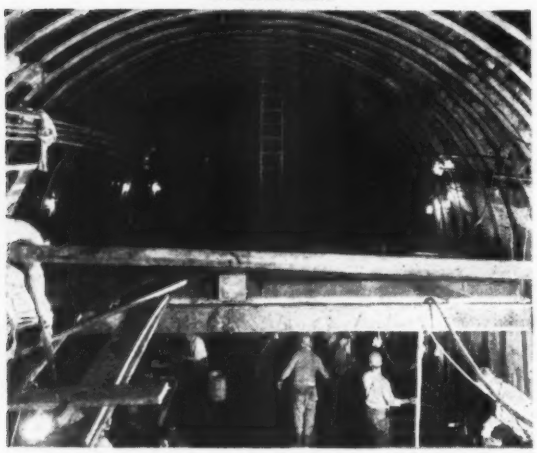
WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

Tank Hoops

Tunnel Ribs



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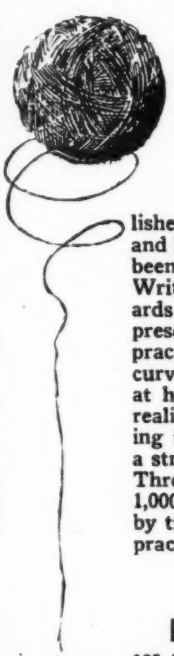

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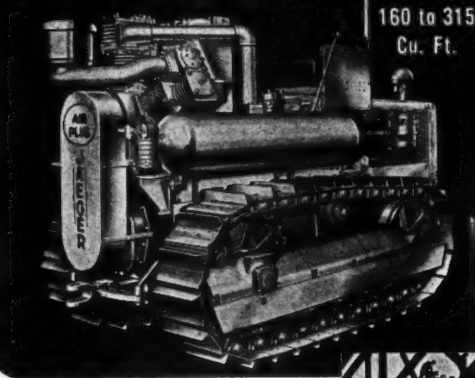
160 to 315 Cu. Ft.



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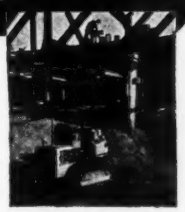

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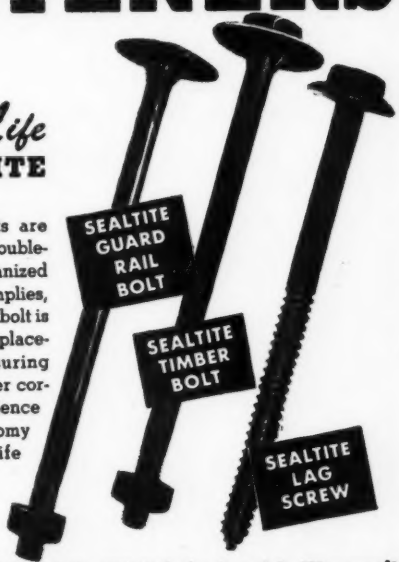

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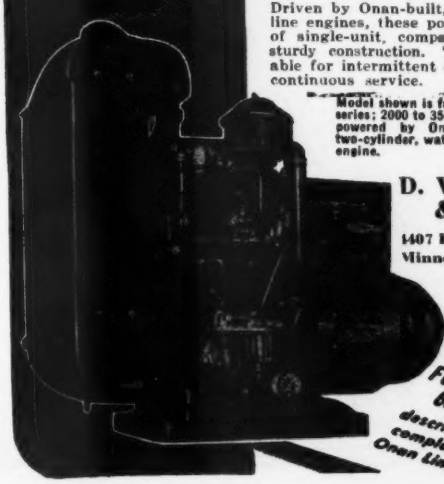

Model shown is from W2C series: 2000 to 3500 watts: powered by Onan-built, two-cylinder, water-cooled engine.

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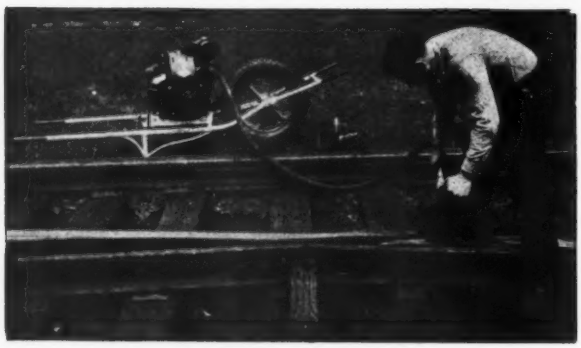
Makes Rolling Stock Last

From its swivel-mounted power unit that permits operator to change working position quickly, right down to its fast-cutting wheel the RTW P-22 Portable Flexible Shaft Grinder is built for *speed*. Light, compact and portable as a wheel-barrow it is a low-cost investment in extended rail life and reduced wear and tear on rolling stock. You can use the P-22 Grinder for surfacing welded rail ends, grinding flangeways, crossings, switchpoints, stock rails; for rail end slotting—and, with attachments, for rapid drilling and cross grinding.

Write for bulletin and prices.



Model P-22 RTW Free-Hand Grinder—one of many models.

Railway Track-work Co.

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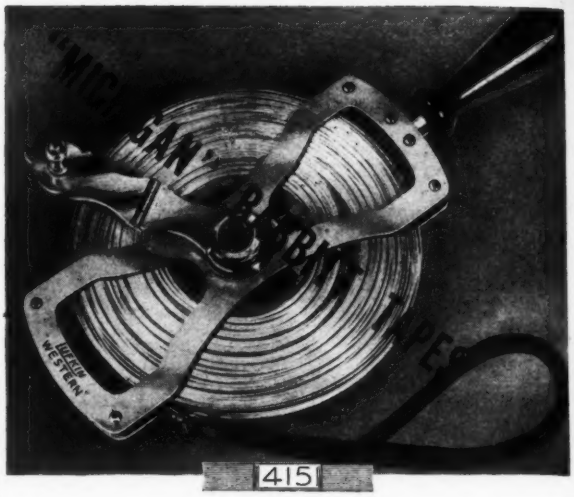

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FOR ROADMASTERS – The ideal crane for maintenance of way operations, handling tracks, frogs, switches – available *where* you need it, *when* you need it.

FOR SHOPS AND STORES–The choice of America's railroads for handling freight, wheels, stores – and repairs.

The RAIL-O-ROAD KRANE KAR has 4 speeds forward, 4 reverse, automatic braking of load and boom, stability without stabilizers or jacks, and handles loads at sides or front. By retracting flanged wheels, the RAIL-O-ROAD KRANE KAR leaves the rails at a siding or crossing. On its rubber tires, it has unexcelled features for indoors and outdoors operation . . . low overhead clearance, short turning radius, unusual maneuverability in close quarters. Gasoline or Diesel, one to 10 ton cap., 11 to 35 ft. booms, solid or pneumatic tires. Agents in principal cities.

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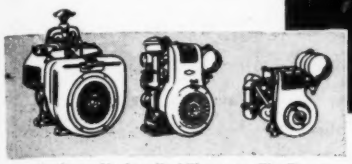

Jackson Hydraulic Vibrators, Tie Tampers, Flexible Shaft Concrete Vibrators and Portable Power Plants, made by Electric Tamper & Equipment Co., Ludington, Mich., employ Wisconsin Heavy-Duty Air-Cooled Engines as standard power equipment. Illustrated above is the Model WS-4 Power Plant equipped with outrigger. Used extensively in railroad roadbed construction and maintenance, bridge construction and related operations, this equipment calls for thoroughly dependable power . . . always ready to go, in any weather and any climate, under rugged conditions. Wisconsin Air-Cooled Engines fill the bill in every particular. Because no equipment is any better than the power that drives it, it pays to specify: "Wisconsin Engine".

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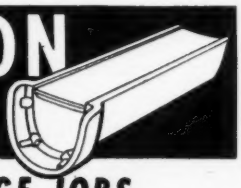
ROBINSON SKIP-PIPE



LICKS DRAINAGE JOBS THAT "STUMPED THE EXPERTS"

Robinson **Skip-Pipe is *the* answer to sub-surface drainage problems that formerly defied solution.**

On Highway Jobs—Robinson Skip-Pipe provides load-carrying marginal drains adjacent to pavement slabs; is used in cut sections to correct sliding conditions; cuts ground water off from pavement subgrades; is used in herringbone systems under slabs to stabilize subgrade.

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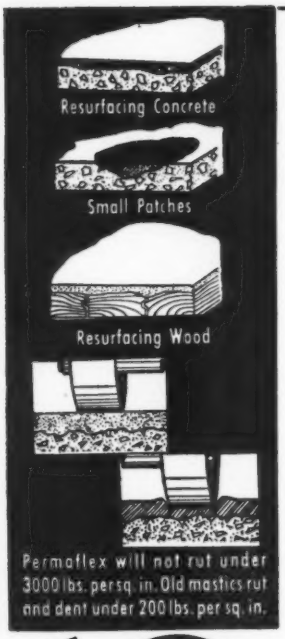
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